

24-24.

Western Electric **LIGHTING** **Manual**



Western Electric **LIGHTING** **Manual**



COMMERCIAL AND INDUSTRIAL LIGHTING

This booklet presents in simple terms the fundamentals of electric lighting. In addition it describes representative systems of lighting and types of fixtures, and offers suggestions to assist in selecting and applying those most appropriate and useful.

Selection of Lighting System

Primarily the governing factor in the choice of a lighting system is the nature of the business, or the activities to be illuminated. Secondly, the architectural and other physical limitations. Lastly, the available systems must be analyzed with a view of adapting them to these conditions.

Systems Available

Lighting fixtures for most interior illumination divide into three main classes. These classes can be subdivided by types, ornamental designs and glassware equipment. Special illumination effects and conditions require special treatment.

Direct Lighting

Direct lighting units are those whose rays of light pass directly from the source of light onto the objects illuminated. To diffuse these direct rays modern practice uses enclosing diffusing globes, or a frosting on the lamp itself.

Semi-Indirect Lighting

In semi-indirect lighting some rays from the source of light are reflected upward to ceiling or an upper reflecting portion of the fixture itself, while others pass directly to the objects to be illuminated. Obviously light colored ceilings and upper walls contribute to the efficiency of a semi-indirect lighting system.

Totally Indirect Lighting

Totally indirect lighting systems direct all rays from the source of light to a ceiling, or a reflector, which redirects them. This system is suitable where a subdued and quiet lighting effect is desired, and here again, light colored ceilings and side walls contribute to efficiency.

Western Electric

Selection of Fixtures

The fixtures described herein have been selected impartially as representative types and will be recognized as products that have been tried and have proved satisfactory. They cover the commercial, industrial and flood lighting fields and some special developments. Each main system of lighting has its particular advantages. Selection of the most suitable unit for a system should be governed by its adaptability to the location to be lighted, its efficiency, appearance and costs, both initial and operating.

Flood Lighting

Flood lighting is intensive direct lighting directionally controlled. It employs units such as projectors and spot lights. It is particularly suitable for lighting out-door operations, such as excavating jobs, steel raising, tunnel work, ship building and a variety of railroad and industrial activities. It is also widely adaptable for lighting monuments, buildings, signs, etc. It is often effectively used in emergencies, such as fires, accident relief work and crime prevention.

Special Lighting

Many conditions do not lend themselves to any of the above mentioned systems and for those cases special units have been developed.

Angle reflectors find a great many uses in industrial plants, also for lighting show windows, show cases, etc.

Spot-lighting, color effects, vapor and water-proof fixtures have also been developed for other special conditions.

Western Electric Service

In 47 important cities the Western Electric Company carries large stocks of lighting units and accessories. At each of its Distributing Houses is a competent lighting specialist whose services are offered to help on lighting problems.

Besides these specialists a central lighting department, with specially trained technical personnel, is maintained at the Company's Executive Offices, 100 East 42nd Street, New York, N. Y.

All lighting problems, large or small, will receive prompt attention without obligation.

The pertinent facts regarding the locations to be lighted, with a simple pencil sketch or blue prints of the floor plan, giving ceiling height and construction, if submitted, will bring detailed specifications and working blue prints from which estimates of cost can be made or which can be used as guides for making the installation.

Complete forms on which all necessary information can be checked off in minimum time, will be furnished on application to any Western Electric Distributing House.

Western Electric

DIRECT LIGHTING = ENCLOSED UNIT

THE "99" UNIT



THE "99" H
(Hanging Type)



THE "99" C
(Ceiling Type)

Cat. No.	Size—Watts	Glass Std. Pk.	*Glass Globe Dimensions			Complete Unit Overall Length	
			Dia.	Depth	Fitter	Hanging Type	Ceiling Type
9975	40—75	4	9"	6 1/4"	4"	29 1/4"	10"
9980	75—100	4	10"	6 1/4"	4"	29 1/4"	10"
9910	100—150	1	12"	7 3/4"	4"	30 3/4"	11 1/4"
9920	200	1	14"	9"	6"	32 1/4"	13 3/4"
9930	300—500	1	16"	10"	6"	33 3/4"	14 3/4"

When ordering indicate Type by H (hanging) C (ceiling) after catalog number.

Asbestos covered wire is supplied with fixtures.

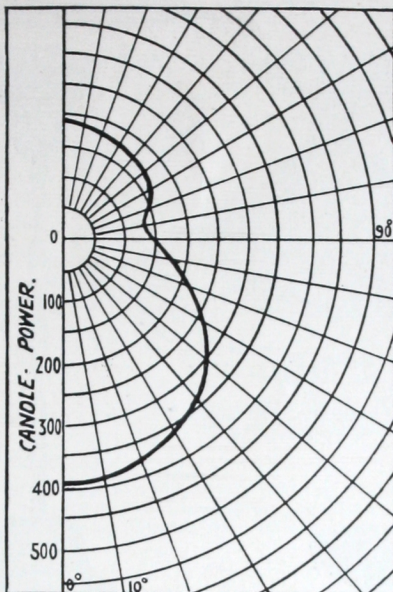
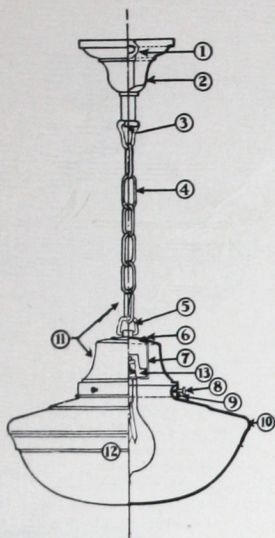
Fixtures and globes are packed separately in individual cartons.

*Globes can be furnished plain or with decorations in cream, rose or taupe colors. Standard designs are illustrated on page six.

Western Electric

DIRECT LIGHTING = ENCLOSED UNIT

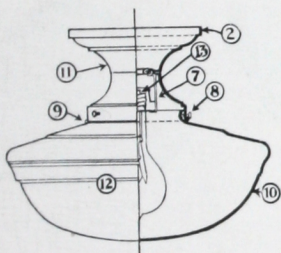
THE "99" UNIT SPECIFICATIONS



DISTRIBUTION CURVE
OF "99" UNIT

Test Lamp, Clear Mazda C
200 Watt, 110 Volts
Output of Clear Lamp 3100 Lumens

Zone	Lumens	Clear Lamp % Total
0- 60	1023	33%
0- 90	1642	53%
90-180	930	30%
0-180	2572	83%



CONSTRUCTION DETAILS OF "99" UNIT

Numbers Refer to Illustrations Above

- 1— $\frac{3}{8}$ " female hickey.
- 2—Oversized canopy that completely covers insulating joint and outlet box, not less than $5\frac{3}{4}$ " diameter, 22 B & S gauge brass.
- 3—Ample wire way for any requirements.
- 4—Extra heavy brass chain, No. 5 B & S gauge, tensile strength not less than 70 lbs.
- 5—Terminal loop notched to permit balancing unit.
- 6—Keyhole slots permit easy removal of porcelain socket for wiring.
- 7—Straps for holding socket are supplied in two lengths to insure correct focusing of lamps.
- 8—Bevel-point holder screws that cannot loosen.
- 9—Snug fitting holder 22 B & S gauge brass excludes dirt and insects.
- 10—Globe of best cased glass insures maximum strength and diffusion with minimum light absorption.
- 11—All metal parts of polished, statuary bronze finish.
- 12—Ventilating not necessary as the large radiating surface carries off the heat.
- 13—Porcelain socket, air insulated from holder.
- 14—General—all units furnished with No. 14 stranded asbestos covered wire.

Western Electric

DIRECT LIGHTING = ENCLOSED UNIT

THE "99 Safety" UNIT



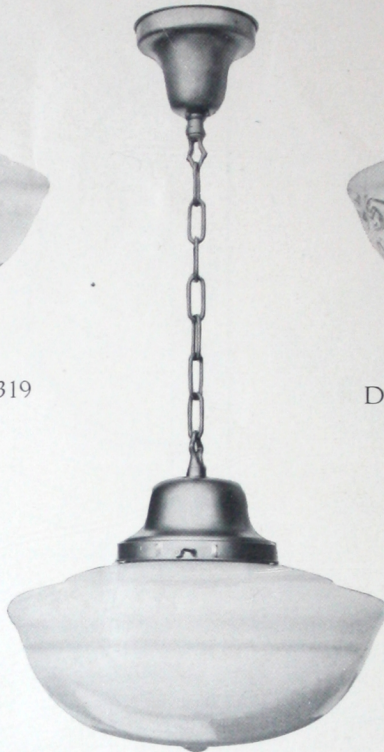
"99 Safety"
SC (Ceiling Type)
Decorated Glass No. 319



"99 Safety"
SC' (Ceiling Type)
Decorated Glass No. 453



"99 Safety"
SC (Ceiling Type)
Decorated Glass No. 332



"99 Safety"
SH (Hanging Type)



"99 Safety"
SC (Ceiling Type)

Cat. No.	Size—Watts	Glass Std. Pk.	*Glass Globe Dimensions			Complete Unit Overall Length	
			Dia.	Depth	Fitter	Hanging Type	Ceiling Type
9975S	40—75	4	9"	6 1/4"	4"	39 1/4"	10"
9980S	75—100	4	10"	6 1/4"	4"	39 1/4"	10"
9910S	100—150	1	12"	7 3/4"	4"	40 1/2"	11 1/4"
9920S	200	1	14"	9"	6"	40 3/4"	16"
9930S	300—500	1	16"	10"	6"	41 3/4"	17"

When ordering indicate Type by H (hanging) C (ceiling) after catalog number.

Fixtures are supplied, wire attached to sockets.

Fixtures and globes are packed separately in individual cartons.

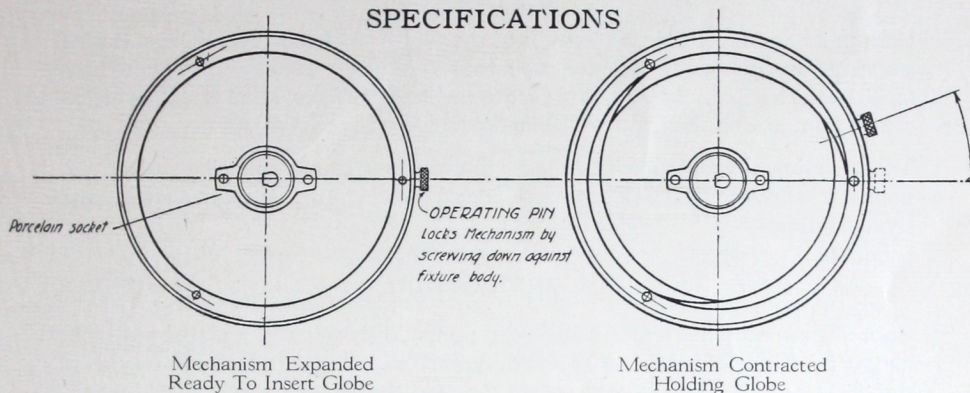
*Globes can be furnished plain or with above decorations in cream, rose or taupe colors.

Western Electric

DIRECT LIGHTING = ENCLOSED UNIT

THE "99 Safety" UNIT

SPECIFICATIONS



General

MECHANISM—Consists of three metal segments, one end of each is held fast, the other end attached to a metal ring which has simple and positive action. Segments are operated by a moving operating pin across a safety slot in which the pin slides. Mechanism is riveted inside the socket holder.

OPERATION—Automatically centers glass; cannot crush it; sufficiently flexible to allow for expansion. Locks in position by screwing the operating pin against fixture body.

SAFETY SLOT—Right-angle shoulder in slot makes it impossible for operating pin to move to open position if not properly locked. Slot is of correct length to take care of variations of size of neck of glass.

FINGER GRIPS—Raised finger grips on either side of operating pin speed up operation and prevent holder rotating. IN and OUT plainly stamped on either side of safety slot show whether mechanism is closed or open.

For distribution curve of the "99 Safety" Unit see Page 5.

Hanger Type Holder

CANOPY—No. 22 B & S gauge brass, extra large size $5\frac{1}{2}$ " diameter by $4\frac{1}{4}$ " deep to facilitate wiring. Slip collar securely fastened and provided with two set screws. Canopy provided with knockout for canopy switch. Upper edge rolled.

HICKEY—Cast brass; $\frac{1}{2}$ " and $\frac{3}{4}$ " female thread.

CANOPY STRAP—Standard strap for mounting on fixture stud, or ears of box.

STEM— $\frac{3}{4}$ " heavy brass tubing threaded to fit brass hickey at one end and brass loop at other.

UPPER LOOP—Cast brass diamond shaped. Threaded to take $\frac{3}{4}$ " brass tubing and drilled with $\frac{7}{16}$ " hole for wireway.

CHAIN—Links perfectly formed from $\frac{1}{4}$ " stock. Size of links $2 \times \frac{7}{8}$ ".

LOWER LOOP—Cast brass diamond shaped, lower surface machined to fit socket cover. Threaded for $\frac{1}{2}$ " nipple and drilled with $\frac{7}{16}$ " hole for wireway.

NIPPLE—Brass, $\frac{1}{2}$ " diameter, $\frac{1}{2}$ " long.

SOCKET COVER—No. 22 B & S gauge brass. Fastened to loop by taking up on lock-nut running on thread of nipple. Has finger grips and safety slot as described above. Lower edge rolled.

SOCKETS—Bryant keyless porcelain sockets.

WIRE—No. 14 Deltabeston stranded wire, one of which has a colored tracer as a marker.

STANDARD FINISH—High grade statuary bronze; each part buffed and polished to insure smoothness of surface and uniformity of color.

Ceiling Type Holder

Made of No. 22 B & S gauge brass with all features of hanger type, including finger grips, safety slot, knockout for canopy switch and rolled edges. Fastens to canopy strap by means of two screws threaded into strap and two barrel-shaped slotted nuts. Bryant one-piece keyless porcelain sockets rigidly held in correct position by two brass posts and wired with No. 14 Deltabeston stranded pigtailed, one of which has a colored tracer as a marker.

Western Electric

DIRECT LIGHTING = ENCLOSED UNIT

THE "99" AND "99 SAFETY" UNITS

General

Both units are direct lighting fixtures of the totally enclosed type. The enclosing globes are dust-proof and bug-proof with smooth outer surfaces and continuous lines facilitating cleaning. By confining dust to the outer surfaces, there is no loss of efficiency from dirt on the lamp or the interior surface of the globe.

The enclosing globe is sufficiently large to provide adequate diffusing surface and shaped so sufficient light reaches the ceiling to dispel ceiling darkness, shadows and sharp contrasts.

Construction

Both units consist primarily of two parts; a metal hanger and a glass bowl. The hanger is entirely of heavy gauge metal, finished in statuary bronze. Two types of suspensions can be obtained; the ceiling type and the hanging type.

The globe is of the best cased glass made of a layer of crystal, then a special white glass lining, inseparably welded when in the molten state. This thin white lining is sufficient to conceal entirely the lamp filament and provides high diffusing qualities with low light absorption. Its graceful contour assures good light distribution. Ventilating is not necessary, if used with the lamps specified, as the large radiating surface carries off the heat.

The "99 Safety" Unit is so called because the globe is held by a concentric ring holder which cinches the globe securely with an even pressure that will not crack it.

The speed with which units equipped with this simple, quick-acting holder can be serviced is a big time and money saver. The saving is particularly apparent when the installation is large.

Where Used

"99" Units can be used practically anywhere indoors where a pleasing, simple fixture, embodying the advantages of a direct system of lighting, is desirable.

Decorative effects can be obtained by the use of the decorated bowls illustrated on Page 6, at a slight additional cost.

Standard decorative bowls are stocked, but special designs can be furnished. Ornamental fixtures of metal or composition are not carried in stock but can be furnished.

The ornamentation of the "99" bowls is colored and fired into the glass forming a permanent decoration.

Packing

The glass and fixture of the "99" are packed separately in individual heavy corrugated paper cartons. Cartons are made to railroad specifications and can be delivered on the job without opening, as labels plainly indicate the contents.

Western Electric

DIRECT LIGHTING = ENCLOSED UNIT

HOW TO PLAN A "99" INSTALLATION

- 1—Determine the spacing of outlets using the following formula:
Average spacing = $1\frac{1}{2}$ x mounting height (distance between working plane and bottom of bowl).
- 2—Determine the required intensity from tables on Pages 36 and 37.
- 3—Determine the room ratio from the following formulas:
$$\text{Room ratio (square room)} = \frac{\text{Room Width}}{2 \times \text{mounting height}}$$
$$\text{Room ratio (rectangular room)} = \frac{2 \times \text{room width} + \text{room length}}{6 \times \text{mounting height}}$$
- 4—Knowing the room ratio determine the Coefficient of Utilization from table below.
- 5—Substitute 1, 2, and 4 in the following formula:
$$\text{Lumens per lamp} = \frac{\text{Area per lamp} \times \text{foot-candle intensity}}{\text{Coefficient of Utilization}}$$

(Add 10 to 15% for unusual dust conditions.)
- 6—Knowing the "Lumens per lamp," look up lamp size in table on Page 32.
- 7—Select the catalog number of the "99" or the "99 Safety" Unit to be used from Page 4 or Page 6, respectively.
- 8—When the building construction is such as to determine the spacing of outlets, the mounting height can be determined from (1) i. e., mounting height = $\frac{2}{3}$ spacing.

COEFFICIENT OF UTILIZATION

Ceiling	Light 70%			Medium 50%		Dark 30%
Walls	Light 50%	Med. 35%	Dark 20%	Med. 35%	Dark 20%	Dark 20%
Room Ratio 1	.32	.28	.28	.28	.25	.25
" " $1\frac{1}{2}$	.39	.35	.33	.34	.31	.30
" " 2	.44	.40	.38	.39	.36	.35
" " 3	.49	.45	.43	.44	.41	.40
" " 5	.54	.50	.48	.49	.46	.45

PROBLEM—Office 60' x 120'. Ceiling height 11' 6". Ceiling light, walls medium. Dusty conditions.

SOLUTION—

- 1—For 11' 6" ceiling, "99" C Type is selected.
Mounting height = 11' 6" less 2' 6" (desk height) less 1' 0" (depth of fixture for ceiling type) = 8'.
Average spacing = $1\frac{1}{2}$ x 8 = 12'.
- 2—Intensity shown in table on Page 36 for office work is 10 foot candles.
- 3—Room ratio as per Paragraph 3 above is:
$$\text{Room ratio} = \frac{2 \times \text{room width (60)} + \text{room length (120)}}{6 \times \text{mounting height (8)}} = \frac{120 + 120}{48} = 5$$
- 4—Coefficient of Utilization (see table above) for light color ceiling and medium color walls room ratio 5 = .50.
- 5—Lumens per lamp =
$$\frac{\text{Area per lamp (144 sq. ft.)} \times \text{Intensity (10 f. c.)}}{.50} = 2880$$

To take care of dust conditions add 10% = 2880 + 288 = 3168.
- 6—Page 32 shows 200 watt Sunbeam Mazda C lamp produces 3100 lumens which is close to the requirements.
- 7—From Pages 4 and 6 note that 9920-C or 9920-SC is the proper ceiling unit to use.

SEMI-DIRECT LIGHTING = SEMI-ENCLOSED UNIT

BRASCOLITE



TYPE AH

Reflector and Band White Glazed Porcelain Enamel

(For Ceiling Mounting Type AF)
(same as Type AH without chains)

TYPES AH AND AF



TYPE YD

Reflector White Glazed Porcelain Enamel
Band and Chain Finished Leather Bronze

(For Ceiling Mounting Type WD)
(same as Type YD without chains)

TYPES YD AND WP

Outer Dia.	Bowl Dia.	Shipping Wt.	Size—Watts	Outer Dia.	Bowl Dia.	Shipping Wt.
10"	6 1/4"	7 lbs.	40—75	11"	6 1/4"	7 lbs.
14"	8 1/4"	12 lbs.	100—150—200	15"	8 1/4"	12 lbs.
18"	11"	22 lbs.	200	19"	11"	22 lbs.
18"	11"	22 lbs.	300	19"	11"	22 lbs.
22"	14"	42 lbs.	400—500	23"	14"	42 lbs.

Specify lamp size with type

AGLITE

PORCELAIN ENAMELED TYPES

The AGLITE units illustrated are of glazed porcelain enamel on Armco steel. Shades are of best quality white glass, making a most efficient, economical and sanitary lighting unit.

Units are quickly and easily assembled and installed by means of invisible patented screw collars.

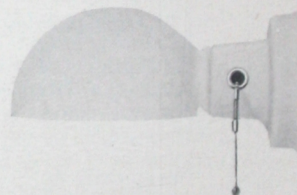
No set screws nor screw heads are visible.

Each unit is complete; all necessary parts being furnished with the fixture.



Type AGW—No Switch

Type AGWS—With Switch



Type AGX—No Switch

Type AGXS—With Switch

Cat. No.	Shade Dia.	Canopy	Shipping Wt.	Std. Pack.
AGW —No Switch	6 1/4"	4 1/2	2 lbs.	4
AGWS—With "	6 1/4"	4 1/2	2 lbs.	4

Cat. No.	Shade Dia.	Canopy	Shipping Wt.	Std. Pack.
AGX —No Switch	8 3/4"	4 1/2	2 lbs.	4
AGXS—With "	8 3/4"	4 1/2	2 lbs.	4

Western Electric

BRASCOLITE

General

This fixture readily lends itself to decorative lighting. Different types of decorated ceiling plates and bowls can be obtained. Stock Brascolite fixtures provide a wide selection to harmonize with any architectural condition. The many designs available assure one fitting perfectly into most schemes of interior decoration. The ornamentation of the fixture itself is accomplished without any loss of efficiency.

As the ceiling plate acts as a substitute ceiling, Brascolite fixtures are particularly well adapted for use where room walls and ceilings are dark. Each type of Brascolite fixture can be obtained for either ceiling or suspension mounting. In general the ceiling type will result in a more pleasing installation.

Construction

The Brascolite fixture consists primarily of two parts, a diffusing bowl and a flat ceiling plate placed a few inches above the bowl.

The underside of the ceiling plate is finished in white glazed porcelain enamel and serves as a reflector to diffuse and direct the light downward. The side of ceiling plate which makes an angle of approximately 45° with the bottom serves to carry the decorative treatment.

The bowl is an important factor in obtaining the characteristic distribution of the Brascolite. It is made of the best grade of opal glass, and designed to give maximum diffusion and minimum glare.

The bowl is suspended below the ceiling plate by means of three adjustable hooks. These hooks allow the bowl to be raised or lowered to take care of slight variations in the lamps. When the bowl is in the proper position the upward light will be confined to the white porcelain enameled section of the ceiling plate. If the bowl is too low a bright ring will appear on the ceiling, and if it is too high, part of the ceiling plate will be in a shadow.

Where Used

The Brascolite carries its own ceiling, which makes it particularly adapted for use in places where dark walls and ceilings make the use of other semi-indirect fixtures inadvisable. The illustrations show but two of the standard designs. However, this fixture is made in a number of styles to suit a wide variety of conditions.

Packing

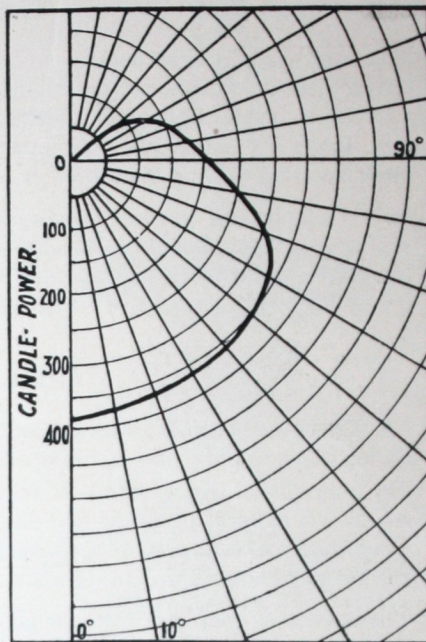
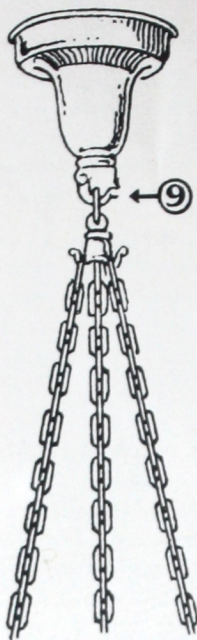
Brascolites are made and shipped complete for installation on any standard outlet. They are packed in unit cartons made to railroad specifications and can be delivered without assembling.

Western Electric

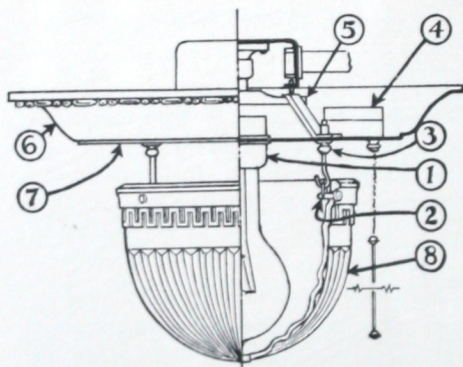
SEMI-DIRECT LIGHTING = SEMI-ENCLOSED UNIT

BRASCOLITE

SPECIFICATIONS



DISTRIBUTION CURVE OF A
BRASCOLITE



CONSTRUCTION DETAILS OF BRASCOLITE UNIT

Numbers refer to illustrations above

- 1—Porcelain socket; medium base No. 51, mogul base No. 101.
- 2—Link engaging spindle to bowl.
- 3—Adjustable spindles—short hook No. 45, long hooks No. 46.
- 4—Pull switch (600 watt) No. 78.
- 5—Standard supporting tripod No. 48.

- 6—Decorative side of reflecting plane.
- 7—Flat reflecting plane; white porcelain enameled.
- 8—Scientifically configured white glass bowl.
- 9—3 chain hanger.
- 10—Standard overall length when 3 chain hanger is used 4 feet.

Test Lamp, Clear Mazda C
200 Watt, 110 Volts
Output of Clear Lamp 3100 Lumens

Zone	Lumens	% Total Clear Lamp
0-60	1088	35%
0-90	1928	62%
90-180	627	20%
0-180	2555	82%

Western Electric

SEMI-DIRECT LIGHTING = SEMI-ENCLOSED UNIT

HOW TO PLAN A BRASCOLITE INSTALLATION

- 1—Determine the spacing of outlets from the following formula:
Average spacing = $1\frac{1}{2} \times$ mounting height (distance between bottom of bowl and working plane).
- 2—Determine the required intensity from Pages 36 and 37.
- 3—Determine room ratio from the following formulas:

$$\text{Room ratio (square room)} = \frac{\text{Room Width}}{2 \times \text{mounting height}}$$

$$\text{Room ratio (rectangular room)} = \frac{2 \times \text{room width} + \text{room length}}{6 \times \text{mounting height}}$$
- 4—Knowing the room ratio determine the Coefficient of Utilization from table below.
- 5—Substitute 1, 2 and 4 in the following formula:

$$\text{Lumens per lamp} = \frac{\text{Area per lamp} \times \text{foot-candle intensity}}{\text{Coefficient of Utilization}}$$
 (Add 10 to 15% for unusual dust conditions.)
- 6—Knowing the "Lumens per lamp" look up the lamp size in table on Page 32.
- 7—Select the catalog number of the Brascolite to be used from table on Page 10.
- 8—When the building construction is such as to determine the spacing of outlets, the mounting height can be determined from (1) i. e., mounting height = $\frac{2}{3}$ spacing.

COEFFICIENT OF UTILIZATION

Ceiling Walls	Light 70% *			Medium 50%		Dark 30%
	Light 50%	Med. 35%	Dark 20%	Med. 35%	Dark 20%	Dark 20%
Room Ratio 1	.32	.28	.26	.27	.25	.23
" " $1\frac{1}{2}$	.40	.36	.33	.34	.32	.30
" " 2	.45	.41	.38	.39	.37	.35
" " 3	.52	.47	.44	.45	.42	.40
" " 5	.59	.54	.51	.51	.48	.46

PROBLEM—Music store, 48' x 60', ceiling height 15', ceiling medium color, walls dark, plane to be lighted 3' above floor. Dusty conditions.

SOLUTION—

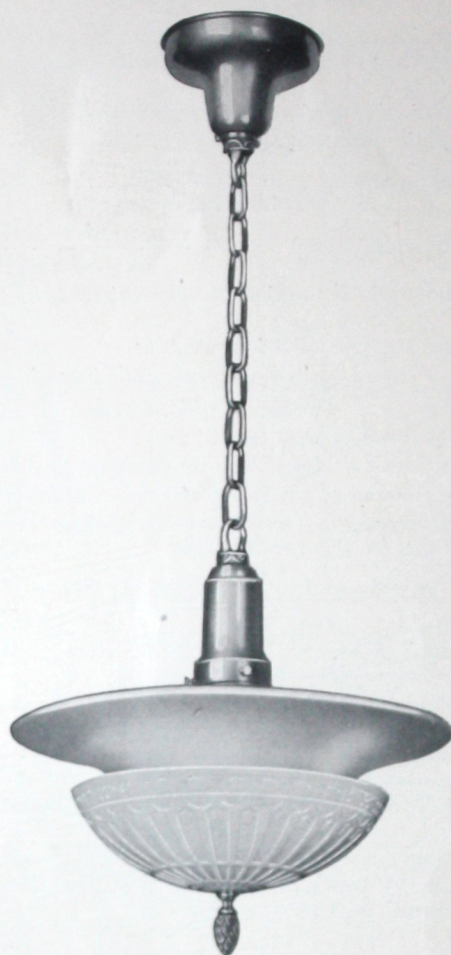
- 1—This is a rather high ceiling and YD Brascolite would suit nicely.
 Mounting height = 15' (ceiling height) less 3' (height of working plane) less 4' (overall hanging length of fixture) = 8'.
 Spacing = $1\frac{1}{2} \times 8 = 12'$.
- 2—Intensity shown in table on Page 36 for Music Store is 6 foot-candles.
- 3—Room ratio as per Paragraph 3 above is:

$$\text{Room ratio} = \frac{2 \times \text{room width (48)} + \text{room length (60)}}{6 \times \text{mounting height (8)}} = \frac{156}{48} = 3.2$$
- 4—Coefficient of Utilization (see table above) for medium ceiling, dark walls, room ratio 3 = .42.
- 5—Lumens per lamp = $\frac{\text{Area per lamp (144 sq. ft.)} \times \text{Intensity (6 f. c.)}}{.42} = 2057$
 To take care of dust conditions add 10% = $2057 + 206 = 2263$.
- 6—Page 32 shows 150 watt Sunbeam Mazda C lamp produces 2145 lumens which is close to the requirements.
- 7—From Page 10 note that the YD (150) Brascolite is the proper unit for this size lamp.

Western Electric

SEMI-INDIRECT LIGHTING UNIT

"77" DUPLEX



THE "77" DUPLEX

The standardized type of luminaire, incorporating the new principle in artificial lighting.

Size—Watts	Type of "77" Duplex Designed for Lamp	Socket	Length Overall	Diameter of Deflector	Diameter of Diffusing Bowl
100	7714	Medium	42"	13 $\frac{3}{4}$ "	10"
150	7714	Medium	42"	13 $\frac{3}{4}$ "	10"
200	7714	Medium	42"	13 $\frac{3}{4}$ "	10"
300	7717	Mogul	60"	16 $\frac{5}{8}$ "	12"
500	7717	Mogul	60"	16 $\frac{5}{8}$ "	12"

Western Electric

SEMI-INDIRECT LIGHTING UNIT

“77” DUPLEX

General

The “77” Duplex embodies the duplex lighting principle—the newest system of semi-indirect lighting. Designed according to this principle most of the light is reflected from the ceiling, only a small portion passes through the diffusing bowl with little or no glare in the angle of vision. As most of the light is indirect, almost perfect ceiling diffusion is obtained. Therefore, the eye functions with the highest visual efficiency and comfort. When ceiling and upper walls are light in color, this semi-indirect system effectively illuminates with thoroughly diffused light and soft shadows.

Construction

The “77” Duplex consists of a canopy, a hanger and patented saddled strap arrangement which holds the canopy in a pendant position, regardless of the angle at which the outlet box is placed. A coppered steel chain fastened to the socket cover suspends the porcelain enamel deflector and the bottom bowl. The detailed diagram on the following page illustrates clearly the ease with which this fixture can be mounted. The socket cover, canopy and chain are finished in a high-class polished brass. The deflector is finished on the outside in a durable, mat-surfaced, very light buff, porcelain enamel. The interior surface of the deflector is polished white enamel.

The bowl is of the best grade opal with special ornamental design.

Where Used

This fixture lends itself readily to decorative treatment by means of shades and ornamental trims. In offices and similar locations where a small amount of direct, downward light with minimum glare and perfect diffusion is desired, this fixture is ideal.

Where eye comfort is of paramount importance, it is secured by combining a light colored ceiling with “77” Duplex Units.

Packing

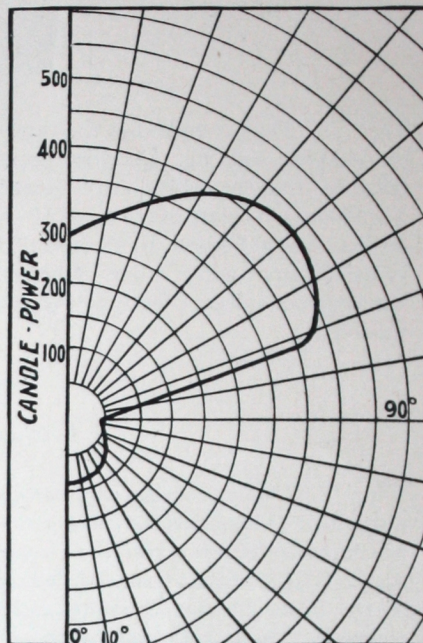
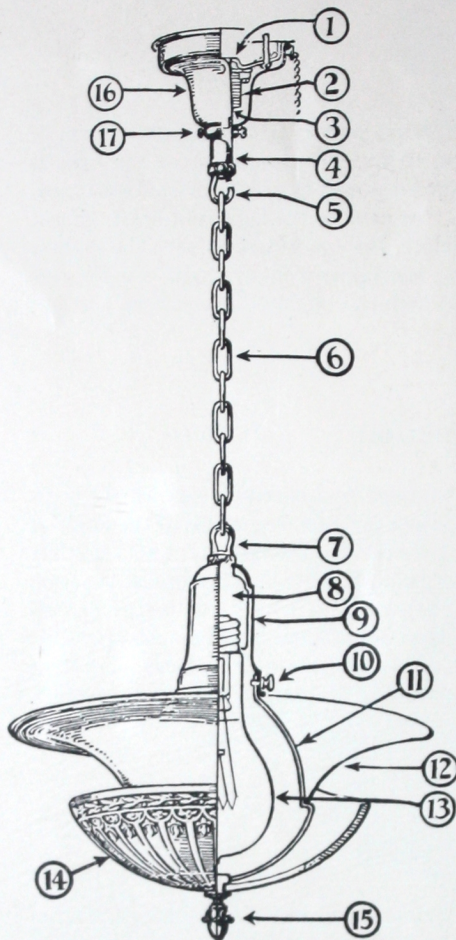
“77” Duplex Units are shipped complete for installing on any standard outlet. The parts can be assembled without the use of tools and are nested to pack in neat, compact corrugated cartons. Attractive labels describe the contents of each carton.

Western Electric

SEMI-INDIRECT LIGHTING UNIT

"77" DUPLEX

SPECIFICATIONS



DISTRIBUTION CURVE OF
"77" DUPLEX

Test Lamp, Clear Mazda C
200 Watts, 110 Volts
Output of Clear Lamp 3100 Lumens

Zone	Lumens	% Total Clear Lamp
0-60	341	11%
0-90	431	14%
90-180	1891	61%
0-180	2322	75%

CONSTRUCTION DETAILS OF "77" DUPLEX UNIT

Numbers Refer to Illustration Above

- | | |
|--|--|
| 1—Canopy strap. | 11—Support frame. |
| 2—Showing how D-29 pullite switch may be placed in the saddle. | 12—Deflector - steel - buff - enameled outside, white porcelain enameled inside. |
| 3—Canopy saddle. | 13—Mazda C lamp. |
| 4—Stem. | 14—Moulded glass bowl designed to eliminate shadows of supports. |
| 5—Cast brass hook. | 15—Ornamental cast brass screw knob. |
| 6—Coppered steel chain—brass finish. | 16—Canopy. |
| 7—Cast brass loop. | 17—Two canopy set screws to center and hold canopy fast. |
| 8—Socket. | |
| 9—Socket cover. | |
| 10—Support frame screw. | |

Western Electric

SEMI-INDIRECT LIGHTING UNIT

HOW TO PLAN A "77" DUPLEX INSTALLATION

- 1—Determine the spacing of outlets using the following formula:
Maximum allowable spacing = $1\frac{2}{3}$ x distance between working plane and ceiling. Having determined the spacing, the hanging length (i. e. the distance from the ceiling to the top of the deflector) is equal to one-fourth of the spacing distance.
- 2—Determine the required intensity from Pages 36 and 37.
- 3—Determine the room ratio from the following formulas:

$$\text{Room ratio (square room)} = \frac{3 \times \text{Room Width}}{4 \times \text{mounting height}}$$

$$\text{Room ratio (rectangular room)} = \frac{2 \times \text{room width} + \text{room length}}{4 \times \text{mounting height}}$$
- 4—Knowing the room ratio determine the Coefficient of Utilization from table below.
- 5—Substitute 1, 2 and 4 in the following formula:

$$\text{Lumens per lamp} = \frac{\text{Area per lamp} \times \text{foot-candle intensity}}{\text{Coefficient of Utilization}}$$
 (Add 15 to 20% for unusual dust conditions.)
- 6—Knowing "Lumens per lamp" look up lamp size in table on Page 32.
- 7—Select the catalog number of the "77" Duplex fixture to be used from Page 14.

COEFFICIENT OF UTILIZATION

Ceiling Walls	Light 70%			Medium 50%		Dark 30%
	Light 50%	Med. 35%	Dark 20%	Med. 35%	Dark 20%	Dark 20%
Room Ratio 1	.25	.23	.21	.18	.17	.13
" " 1½	.31	.28	.26	.23	.21	.16
" " 2	.34	.32	.30	.26	.24	.18
" " 3	.39	.37	.35	.30	.28	.21
" " 5	.45	.43	.41	.34	.32	.24

PROBLEM—Clothing Store, 28' x 60', 12' ceiling. Ceiling light, walls medium. Working plane 3' above floor. Dust conditions normal.

SOLUTION—

- 1—Mounting height = 12' (ceiling height) less 3' (height of working plane) = 9'.
Maximum allowable spacing = $1\frac{2}{3}$ x mounting height (9') = 15'.
In order to obtain even spacings and to keep within the maximum, use 14' x 15' spacings.
Hanging length = $\frac{1}{4}$ x 15' = 3' 9".
- 2—From Page 36 the desirable intensity for a clothing store under usual conditions is 8 foot-candles.
- 3—The room ratio as per Paragraph 3 above is:

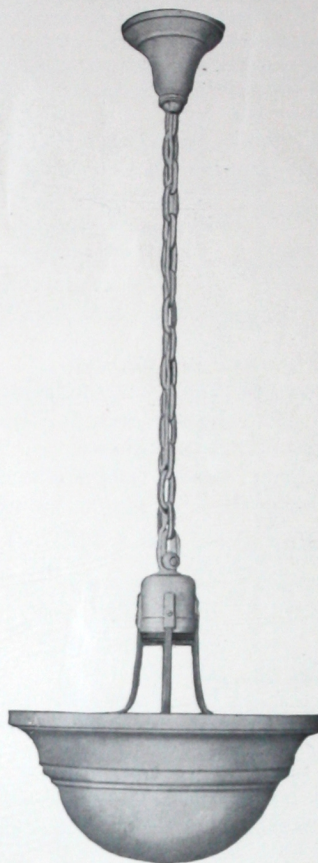
$$\text{Room ratio} = \frac{2 \times \text{room width (28')} + \text{room length (60')}}{4 \times \text{mounting height (9')}} = \frac{56 + 60}{36} = 3.22$$
- 4—The nearest value of the room ratio in above table is 3. Using this value under light ceiling and medium walls find the Coefficient of Utilization equal to .37.
- 5—Substituting in the following formula:

$$\text{Lumens per lamp} = \frac{\text{Area per lamp (210)} \times \text{f. c. Intensity (8)}}{\text{Coefficient of Utilization .37}} = 4540$$
 Due to dust conditions being normal nothing is added for depreciation due to this cause.
- 6—From table on Page 32 the lamp producing nearest this quantity of light is the 300 watt Sunbeam Mazda C lamp which produces 4950 lumens.
- 7—From Page 14 the catalog number of the "77" Duplex fixture for use with a 300 watt lamp is No. 7717.

Western Electric

TOTALLY INDIRECT LIGHTING UNIT

X-RAY "48"



X-RAY "48" UNIT COMPLETE



REFLECTOR USED
IN X-RAY "48" UNIT

Cat. No.	Size—Watts	Bowl Dia.	Bowl Depth	Reflector
4801-V	100—150	14"	6"	E. C. 12 9½" diam.
4801-W	200	14"	6"	E. C. 12 9½" diam.
4801-M	300—500	14"	6"	E. C. 345 12" diam.

Western Electric

TOTALLY INDIRECT LIGHTING UNIT

X-RAY "48"

General

In the X-Ray "48" Unit the light from the source is directed to the ceiling, a relatively large area, which in turn reflects it back into the room. The resultant illumination is characterized by absence of high brilliancy light sources, pleasing uniformity of illumination and good diffusion.

The comfort and artistic effects possible with this system more than offset the slight increase in expenditure necessary to obtain it.

The X-Ray "48" embodies the essentials necessary for economic and artistic indirect lighting.

Construction

This unit is built around the most powerful reflecting surface, an X-Ray reflector which is scientific in design, of permanent efficiency, and low maintenance cost.

The housing of stamped steel is finished in a cream colored washable enamel. It is made in graceful lines and being of cream color is sufficiently neutral to go well with most interior walls and ceilings.

The housing is supported and attached to the special socket by three inconspicuous arms. The detailed sketch on the following page shows that the whole fixture from the canopy to the bowl is the product of the highest class of workmanship.

Bushing and coupling supplied facilitate installation on either $\frac{3}{8}$ or $\frac{1}{2}$ inch stud, or the running-thread piece may be fastened into crowfoot if necessary. One screw terminal and one end of wire are marked in black for correct grounding. The X-Ray "48" is easy to assemble and install.

Where Used

Where softness of shadows and entire freedom from glare are primary requirements in interiors with light-colored ceilings and upper side-walls the X-Ray "48" will produce the desired results.

Such places as libraries, drafting rooms, theatres, restaurants, hospitals, etc., are effectively lighted with this unit.

As for all lighting equipment a regular maintenance schedule should be maintained. The collection of dirt or continued use of blackened lamps reduces efficiency very materially.

Packing

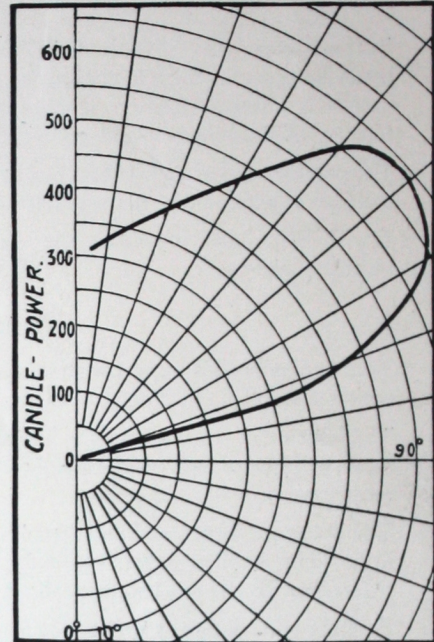
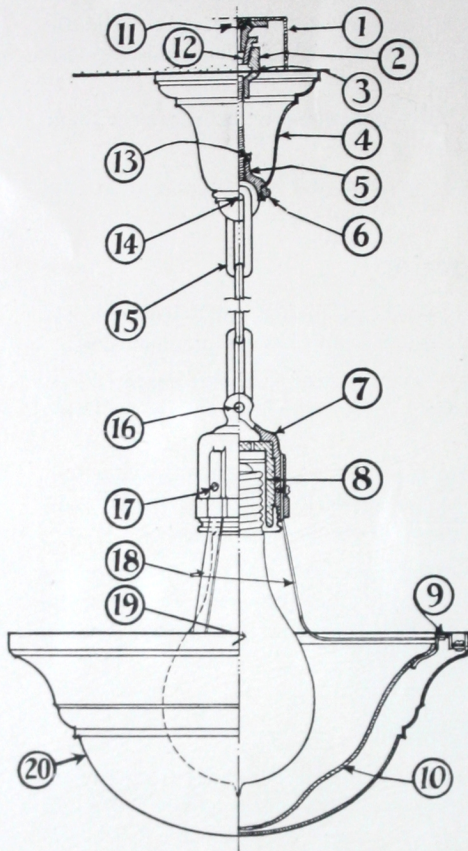
The fixture is packed unwired and arranged in every detail for easy installation. Each fixture complete is packed in a neat substantial corrugated carton which insures delivery in perfect condition. The exterior of the carton is properly marked designating by illustration and type all details of the contents.

Western Electric

TOTALLY INDIRECT LIGHTING UNIT

X-RAY "48"

SPECIFICATIONS



DISTRIBUTION CURVE OF
X-RAY "48"

Test Lamp, Clear Mazda C
200 Watts, 110 Volts
Output of Clear Lamp 3100 Lumens

Zone	Lumens	Clear Lamp % Total
0-60	....	....
0-90	....	....
90-180	2480	80%
0-180	2480	80%

CONSTRUCTION DETAILS OF X-RAY "48" UNIT

Numbers Refer to Illustration Above

- | | |
|--|--|
| 1—Outlet box. | 13—Locknut. |
| 2—Coupling. | 14—Pin. |
| 3—Ceiling line. | 15—Neat pendant method of suspension
with well-proportioned chain links of
liberal size. |
| 4—Canopy. | 16—Screw. |
| 5—Hickey. | 17—Arm retaining screw. |
| 6—Canopy ring. | 18—Simple method of attaching arm sus-
pensions to fixture. |
| 7—Socket (special). | 19—Mazda C lamp. |
| 8—Porcelain interior parts insulating
socket from socket cover. | 20—Outer bowl of good steel, washable
enamel cream finish. |
| 9—Lugs. | |
| 10—X-Ray reflector insures high efficiency. | |
| 11—Fixture stud. | |
| 12—Bushing. | |

Western Electric

TOTALLY INDIRECT LIGHTING UNIT

HOW TO PLAN AN X-RAY "48" INSTALLATION

- Determine the spacing of outlets using the following formula:
Maximum allowable spacing = $1\frac{2}{3}$ distance between ceiling and working plane.
Having determined the spacing; the hanging length (i. e. the distance from the ceiling to the top of the reflector) is equal to one-fifth of the spacing distance.
- Determine the required intensity from Pages 36 and 37.
- Determine the room ratio from the following formulas:
Room ratio (square room) = $\frac{3 \times \text{Room Width}}{4 \times \text{mounting height}}$
Room ratio (rectangular room) = $\frac{2 \times \text{room width} + \text{room length}}{4 \times \text{mounting height}}$
- Knowing the room ratio determine the Coefficient of Utilization from table below.
- Substitute 1, 2 and 4 in the following formula:
Lumens per lamp = $\frac{\text{Area per lamp} \times \text{foot-candle intensity}}{\text{Coefficient of Utilization}}$
(Add 15 to 20% for unusual dust conditions.)
- Knowing "Lumens per lamp" look up lamp size in tables on Page 32.
- Select the catalog number of the X-Ray indirect unit to be used from Page 18.

COEFFICIENT OF UTILIZATION

Ceiling Walls	Light 70%			Medium 50%		Dark 30%
	Light 50%	Med. 35%	Dark 20%	Med. 35%	Dark 20%	Dark 20%
Room Ratio 1	.22	.19	.17	.14	.12	.07
" " 1½	.27	.24	.22	.17	.15	.09
" " 2	.31	.28	.26	.20	.18	.11
" " 3	.36	.33	.31	.24	.22	.13
" " 5	.42	.39	.37	.28	.26	.16

PROBLEM—Office 48' x 72'. Ceiling height 11', walls and ceiling light color.
Working plane 2' 6". Dust conditions normal.

SOLUTION—

- Mounting height = 11' (ceiling height) less 2' 6" (height of working plane) = 8' 6".
Maximum Allowable Spacing = $1\frac{2}{3} \times \text{Mounting height (8' 6")}$ = 14' 2".
In order to have uniform spacings and keep below the maximum allowable use 14' spacings.
Hanging Length = $\frac{1}{5} \times 14$ = 2' 9".
- From Page 36 the desirable intensity for an office is found to be 10 foot-candles.
- The room ratio as per Paragraph 3 above is:
Room ratio = $\frac{2 \times \text{room width (48')} + \text{room length (72')}}{4 \times \text{mounting height (8.5')}} = \frac{96 + 72}{34} = 4.95$
- The nearest value of this room ratio in above table is 5. Using this value, under light walls and ceilings find Coefficient of Utilization = .42.
- Substituting known values in the following formula find lumens per lamp.
Lumens per lamp = $\frac{\text{Area per lamp (196)} \times \text{f. c. intensity (10)}}{\text{Coefficient of Utilization .42}} = 4667$
Due to dust conditions being normal, nothing need be added for depreciation due to this cause.
- Page 32 shows the lamp producing nearest this quantity of light is the 300 watt Sunbeam Mazda C lamp which produces 4950 lumens.
- Looking on Page 18, the catalog number of fixture to be used is 4801-M.

Western Electric

SHOW WINDOW LIGHTING

X-RAY SILVER MIRRORED REFLECTORS

Universally used and everywhere recognized as standard Show Window Lighting Equipment.

For Deep Windows
600 Jove

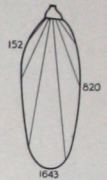
Distribution
for deep win-
dows



Deep windows or windows with high trim require a distributing type of reflector to light uniformly the entire display from top to bottom

For Shallow Windows
610 Jupiter

Distribution
for shallow
windows



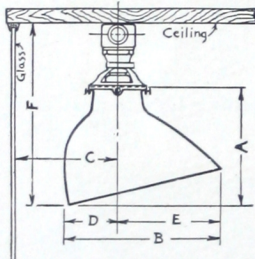
Shallow windows are those which have no trim or are less than half as deep as they are high. These windows having no background require a concentrating type of reflector

Cat. No.	Windows	Size-Watts	Holders	St'd. Pkg.
600 Jove	More than 8' high	150-100	3 1/4" Form A	12
778 Scoop	5' to 8' high	75	2 1/4" Form O	24
7 Scoop Jr.	Less than 5' high	50	2 1/4" Form O	40

Cat. No.	Windows	Size-Watts	Holders	St'd. Pkg.
610 Jupiter	More than 8' high	150-100	3 1/4" Form A	12
731 Hood	5' to 8' high	75	2 1/4" Form H	16
11 Hood Jr.	Less than 5' high	50	2 1/4" Form O	40

Spacing of Reflectors

The closer the reflectors are spaced, the brighter the windows and vice versa. In average installations the spacing from center to center along the glass is from 18 to 24 inches. Where neighboring stores are not brightly lighted, 24 to 30 inches between centers may be satisfactory. In brightly lighted sections from 12 to 18 inches is generally advisable.



Reflec- tor No.	Width	A Height	B Depth	C	D	E	F
610	10"	7 3/8"	10 1/8"	6 1/4"	3 7/8"	6 1/4"	11 1/4"
600	10"	7 3/8"	9 5/8"	6 1/4"	3 5/8"	6 3/8"	11 1/4"
778	7 3/8"	6 5/8"	6 1/8"	5 1/2"	2 3/8"	3 1/8"	9 7/8"
731	8 7/8"	6 3/8"	8 7/8"	6"	3 3/8"	5 9/16"	9 9/16"
11	5 1/2"	3 3/8"	5 7/8"	4 1/2"	1 5/8"	3 5/8"	6 7/8"
7	5"	3 7/8"	4 7/8"	4 1/2"	1 5/8"	2 5/8"	6 5/8"



No. 33 (200 watt lamp) includes color equipment. No. 88 (500 watt lamp) without color equipment

X-Ray Flood Ray With Center Spot Beam

Window flood lighting gives real stage lighting effects, white or color flood and spot lighting all from one X-Ray Reflector, used in large or small windows whether or not other lighting is available.

Information on special window lighting effects—foot lighting, spot lighting, color lighting—will be gladly furnished on application to our nearest House



No. 303 is No. 33 on portable stand. No. 808 is No. 88 on portable stand

Western Electric

SHOW CASE LIGHTING

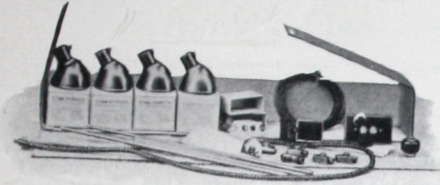
X-RAY SCOOPETTE EQUIPMENT

The show-case as used today is in reality a miniature show-window, hence, its illumination should receive as careful consideration as show-window lighting. The lighting requirements are very nearly the same except that in show-case lighting it is not only necessary to conceal the lamp from the view of the customer, but it is also essential to shield the eyes of the clerk.

X-Ray Scoopette reflectors and fittings have been designed to fulfill the above lighting requirements.

The Scoopette reflector consists of a silvered glass reflector similar to the larger X-Ray reflectors, and a metal housing which encloses and protects it. It is designed to take the standard 15-watt or 25-watt G-18½ medium screw base Mazda lamp.

A special line of fittings has been developed for use in wiring the Scoopettes in all kinds of show-cases, bank cases, wall cases and cabinets. The type of case to be fitted should be specified when ordering.



The Package Opened

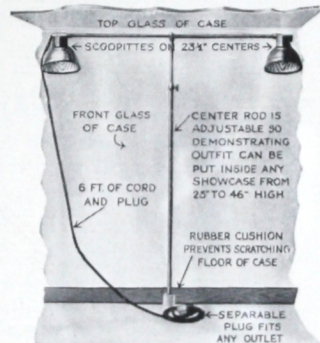
Each X-Ray Scoopette equipment is furnished complete, less lamps, for installing in the standard type "Wood Frame" or "All Glass" show-cases. All material is included for assembling and wiring such as tubing, fittings, switch, insulating joint and wire. Conditions for wiring vary slightly in different localities, therefore Scoopette equipments are shipped unassembled and unwired.

Equipments are arranged for wiring in straight multiple, just as the ordinary commercial lighting circuits are connected.

The electric wires are contained in small metal tubing, making the installation fireproof, and are scarcely noticeable. The equipment will pass electrical inspection anywhere.

All metal parts are finished in a black nickel that harmonizes with all display cases.

A portable Scoopette Outfit (catalog S-140) can be secured for demonstrating in the merchant's show-cases. This outfit includes two Scoopettes mounted on a tubing furnished with an adjustable center supported rod with rubber cushion on bottom. This outfit is all wired with 6 feet of cord and plug and is easily set up in any display case. The idea of this demonstrating outfit is to let the merchant see the lighting results he will get. With Scoopettes in standard package outfits available for quick delivery for standard 6 or 8 foot cases (either all glass or wood frame cases) this demonstrator should be a great help.



The S-140 Demonstrator

Installation Data

The spacing between Scoopettes in the show-case depends on the nature of the goods displayed in the case, and the location of the case itself. To be effectively lighted the show-case must be brighter than the interior illumination of the store. Although no exact rule can be established, the table here shown as a guide indicates the limits within which a satisfactory installation can be made with 15-watt lamps. By using 25-watt lamps, a higher intensity of illumination will result.

No. of Units

Length of Case	2	3	4	5	6	7	8	9	10
3'- 5'	A	B	VB						
5'- 7'	X	A	B	VB					
7'- 9'		X	A	B	VB	S			
9'-11'			X	A	B	VB	S	S	S
11'-13'				X	A	B	VB	S	S
13'-15'					X	A	B	B	S

A = Average B = Bright VB = Very Bright S = Especially Brilliant X = Below Average

Western Electric

INDUSTRIAL LIGHTING

ILLUMINATION

Good illumination in a factory is more important than plenty of space. No matter how well planned the routing of work nor how specialized the machinery,—production is restricted unless the assistance of good illumination is provided. Good illumination means that men and machines have a fair chance to do and to give all they can. Even poor equipment can be made to do a better job, if that job is done under correct lighting.

General Lighting vs. Local Lighting

To secure the desired results lighting engineers have turned now to so-called "general lighting" rather than the previously prevalent "local lighting." General lighting is secured by a type of installation employing a relatively small number of highly intensive sources of illumination (fixtures and lamps), rather widely spaced and mounted relatively high above the floor or working plane. Local lighting employs individual units of low intensity placed at variable heights and variable spacing distances to satisfy local conditions, but sacrifices general diffusion of the light. Local lighting gives a number of brilliantly lighted areas surrounded by sections of comparatively dark flooring, machines and spaces. This leads to eye fatigue and consequent inaccuracies in workmanship, to spoilage and frequently to accidents to workmen and machines. General lighting eliminates this handicap and therefore is more desirable from an illumination standpoint.

Laying Out Installations

In laying out a system of illumination, intensity—uniformity—glare, must be considered individually and collectively in their relations to each other.

Intensity

The intensity required depends largely on working conditions. For rough work, a moderate intensity is adequate, whereas, for finer work such as weaving or fine machine work, the illumination must be strong enough to enable the operator to see clearly without eye-strain. Where walls and ceilings are dark or dusty, the intensity will have to be higher than if light colored and clean. On Pages 36 and 37 is a table giving the intensities suitable for average industrial conditions.

Uniformity

With any system of general lighting uniform distribution is highly desirable. That is, intensities at all points on the same working plane should be equal. This is obtained by keeping constant the ratio between the spacing distances and mounting heights of the reflectors. Different types of reflectors call for a different spacing ratio.

Glare

Glare injures the eyes, it interferes with clear vision, it increases the risk of accident and naturally lowers the efficiency of the workers. Lighting equipment must be so chosen, mounted and equipped with reflectors and diffusing means as to minimize the glare.

Western Electric

INDUSTRIAL LIGHTING

REFLECTORS

Porcelain Enamel Reflectors

Of all the materials tried out for industrial lighting reflectors, porcelain enameled steel is apparently the only one that meets the severe requirements. Its reflecting efficiency is high. It is not fragile. It resists corrosion from fumes and smoke. It is easily cleaned. In short, it is the most economical in the end and the most suitable for practically all industrial conditions.

Due to numerous requirements and the many styles of reflectors available, care is necessary to assure selection of the proper type of porcelain steel reflector for an industrial installation.

The Benjamin Line of Reflectors

The Benjamin Reflectors illustrated here are of the highest quality porcelain enamel types. They are carefully designed and manufactured for efficiency and adaptability under a wide variety of local conditions. A special characteristic is their insuring the correct position of the Mazda lamp in each type of reflector.

R L M Reflectors

Through cooperation of the illuminating engineers of the leading manufacturers of reflectors and lamps a harmonious design for a reflector for general illumination was developed. It is known as the RLM (reflector and lamp manufacturers' standard) and is of dome shape. It is adapted to give a uniform illumination over an entire workroom rather than to illuminate special areas as in local lighting. It is well to remember that, while the RLM Reflectors are for general illumination, there are cases which, on account of the architectural arrangement of the building or the work at hand, call for other types of reflectors.

Glassteel Diffusers

In many institutions it is desirable to illuminate the areas above the reflector so as to soften the contrast with the brighter plane below. The Glassteel Diffuser accomplishes this, and in addition is pleasing in appearance, enhances the cheerfulness of the room and prevents eye discomfort. The unit consists of a white porcelain enameled steel reflector, with six apertures at top for the passage of light to the ceiling. The lamp is enclosed in a glass globe. This type is particularly adapted to the use of Daylight (Type C-2) lamp.

Bowl Reflector

It is not to be expected that one type of reflector could meet the requirements for lighting all conditions. There are many cases in industrial plants where the illuminating effect produced by the RLM Reflector or Glassteel Diffuser is not the one most suitable. Where an almost entire elimination of shadows is not essential and where illumination of vertical surfaces is of minor importance, the Bowl Reflector satisfies. The Bowl Reflector also serves well where it is found necessary to light an individual machine or bench.

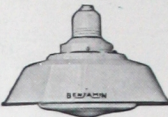
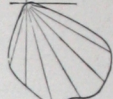
Elliptical Angle Reflector

In mills, where traveling cranes are used or moving machinery occupies the center of the space, it is frequently impossible to hang lighting units other than at the sides of the space. Here the Elliptical Angle Reflector properly installed will furnish desirable results. It is also used to good advantage in billboard lighting.

Western Electric

INDUSTRIAL LIGHTING

BENJAMIN PORCELAIN ENAMELED REFLECTORS

RLM DOME		Shade Holder Reflectors	Glassteel Diffusers	Bowl Reflector Sockets	Elliptical Angle Reflectors
Reflector Sockets					
					
					
Size Watts					
40					
50	No. 5640	No. 14050		No. X6166	No. 5522
60	Dia. 12"	Dia. 12"		Dia. 7"	Dia. 8 7/8" x 13 1/4"
75	No. 5641	No. 14075		No. X6161	No. 5522
	Dia. 12"	Dia. 12"		Dia. 8 1/4"	Dia. 8 7/8" x 13 1/4"
100	No. 5642	No. 14100		No. X6189	No. 5525
150	Dia. 14"	Dia. 14"		Dia. 9"	Dia. 8 7/8" x 13 1/4"
200	No. 5643	No. 14200	No. 26300	No. X6169	No. 5526
	Dia. 16"	Dia. 16"	Dia. 18"	Dia. 10"	Dia. 11 1/8" x 16 3/8"
300	No. 5644		No. 26302	No. X6173	No. 5537
500	Dia. 18"		Dia. 20"	Dia. 17"	Dia. 13 7/8" x 19 7/8"
750	No. 5645				No. 5538
1000	Dia. 20"				Dia. 13 7/8" x 19 7/8"

All reflectors shown here, with the exception of the Glassteel Diffuser, are seamless one-piece stamped from heavy gauge steel, porcelain enameled in green outside and white inside. The Glassteel Diffusers are seamless one-piece stamped from heavy gauge steel, porcelain enameled in white outside and inside, with six apertures at top and a glass globe.

Reflector socket types are tapped for 1/2" pipe fitting complete with a two-piece porcelain, keyless socket, having easy-to-wire features and Benjamin lamp grip which prevents loosening and falling of lamps.

The shade holder types are provided with various necks to adapt to existing conditions as illustrated below.

All above reflectors, with the exception of Glassteel Diffusers, are packed ten to a carton. Standard package for Glassteel Diffusers is four.



Type B Holder
For Standard
Brass Shell Socket



Type P Holder
For Standard
Porcelain Socket



Type N Holder
For Standard 2 1/4
Shade Holder



Type S Holder
For Screw
Thread Fitting



Type A Holder
For Ben-ox
Devices

Western Electric

INDUSTRIAL LIGHTING

HOW TO INSTALL INDUSTRIAL REFLECTORS

Mounting Height and Spacing Ratio

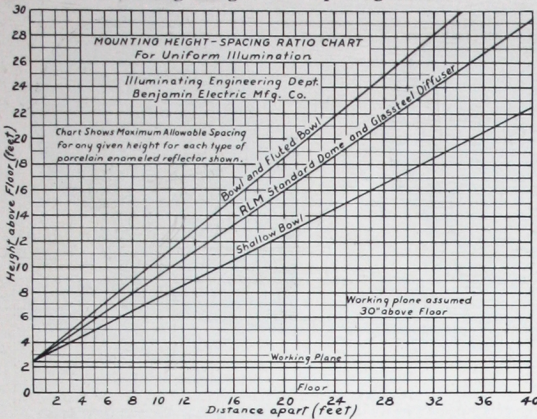


CHART A

3. Find the Size of Lamp required in Chart B by determining the curved line passing closest to the intersection of the figures representing the area in square feet to be lighted by each lamp and the intensity in foot candles required for the work. The catalog number of the reflector is found on Page 26.

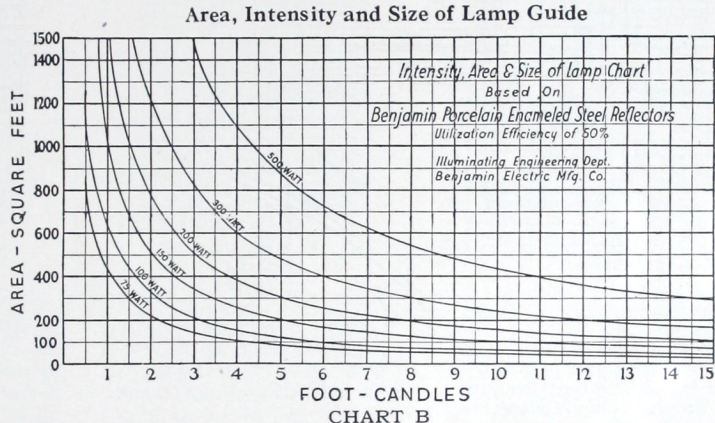


CHART B

Specifications for Painted Sign and Poster Board Illumination

The Elliptical Angle Reflector has a broad oval form of distribution. The greatest intensity is at each side of the unit which builds up the intensity between units. Therefore it is excellent for sign board illumination. The following table gives specifications for mounting Elliptical Angle Reflectors for this purpose. In each package of ten reflectors is an instruction sheet giving complete instructions for installation.

Mounting Data for Elliptical Angle Reflectors

Type of Board	Height of Board	Size-Watts	Reflector Number	Mounting Dimensions		
				Apart	From End	Out
25' Poster	10' or 11'	100	5525	8' 3"	4' 3"	5' 6"
48' Poster	10' or 11'	100	5525	8' 0"	4' 0"	5' 6"
45' Painted	12'	200	5526	9' 0"	4' 6"	6' 0"
50' Painted	12'	200	5526	8' 6"	4' 3"	6' 0"
Painted Walls and Painted Signs	2' to 4'	75	5522	5'	2' 6"	3'
	5' to 6'	100	5525	6'	3'	4'
	7' to 8'	150	5525	6' 6"	3' 3"	4' 6"
	9' to 12'	200	5526	8'	4'	5' 6"
	13' to 16'	300	5537	10'	5'	6' 6"
	17' to 21'	500	5537	13'	6' 6"	9'
	22' to 25'	750	5538	17'	8' 6"	12'
	26' to 30'	1000	5538	20'	10'	15'

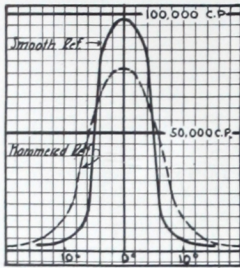
Western Electric

FLOOD LIGHTING

DAVIS FLOODLIGHT PROJECTORS



No. I-W



I-W Distribution Curve

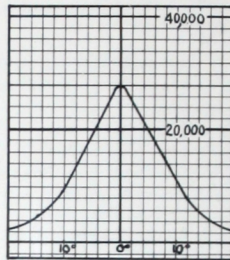
The Model I-W Projector is particularly suitable for illuminating large areas such as playgrounds, railroad yards, beaches, etc., where a throw of 1000 to 1500 feet is necessary. Its cast iron housing makes it adaptable for severe conditions.

It takes the 750 watt or the 1000 watt Sunbeam Mazda C Lamp in the standard pear shape bulb.

Plain or hammered reflectors are available, the hammered type is supplied unless otherwise specified.



No. PS-5



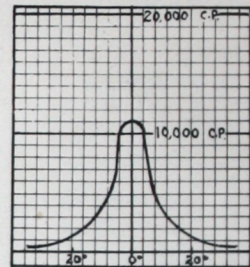
No. PS-5 Distribution Curve

The Model PS-5 Reflector is designed for lighting comparatively large areas at approximately 500 feet distance. Its housing is made of cast aluminum and the hammered glass reflector is supplied.

It takes a 300 or 500 watt Sunbeam Mazda C Lamp in the standard pear shape bulb.



No. PS-2



No. PS-2 Distribution Curve

The Model PS-2 Projector is designed for the same service as the PS-5, except that it is limited to throws of 250 to 300 feet. Its housing is made of cast aluminum, and the hammered glass reflector is supplied.

It can be used successfully for many indoor applications.

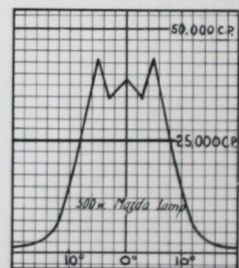
It takes the standard 200 watt, PS Bulb Sunbeam Mazda C Lamp.



Sunlight

Sunlight Projectors

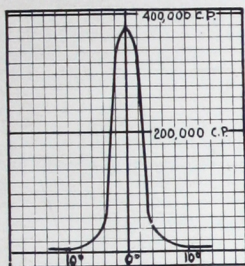
The Sunlight Projector is a simply constructed type suitable for indoor use or outdoor applications where ruggedness is not of prime importance. Its housing is of spun aluminum, highly polished on the inside to form the reflector. It is popular for temporary lighting on night excavating jobs. It is supplied with or without front glass and provided with a simple socket adjustment to adapt it for use of 300 to 500 watt Sunbeam Mazda C Lamps. The 100, 150 or 200 watt lamps can also be used by employing a reducer to take the medium base.



Sunlight Distribution Curve

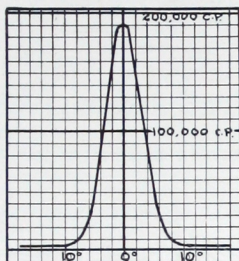
Western Electric

DAVIS FLOODLIGHT PROJECTORS



The Searchlight is exactly what the name implies; a narrow beam projector of great accuracy throwing a narrow, intense beam of light. It fills the demand for a projector to pick up distant objects, to illuminate the uppermost and inaccessible tops of buildings, statues, etc.

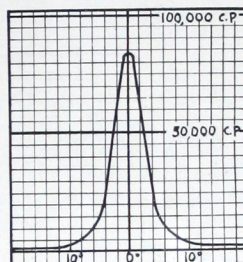
The housing is made of Armco steel, shielding an accurately ground and polished reflector. It is designed to take 500, 750, 1000 or 1500 watt Standard Sunbeam G-Bulb Mazda C Lamps.



The G-5 Beam Light Projector is made to use where a narrow beam is desired for projecting a distance of about 500 feet to light a relatively small area, such as a sign or water tower.

Its housing is of cast aluminum, and the reflector supplied is the smooth mirror glass type.

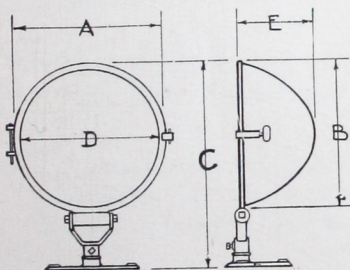
It takes 500 watt Standard G-Bulb Sunbeam Mazda C Lamp.



The G-250 Beam Light is designed for practically the same service as the G-5 except that it is more adaptable for throws of 200 to 300 feet. It has many indoor applications.

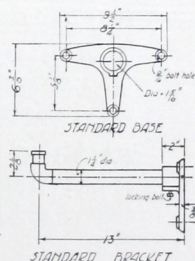
Its housing is cast aluminum and smooth silvered reflectors are supplied.

It is designed to take the 250 watt Standard G-Bulb Sunbeam Mazda C Lamp.



DIMENSIONS

Projector	A in.	B in.	C in.	D in.	E in.	Wght. Net	Lbs. Ship
Searchlight	12½	12½	20	12½	11	20	35
G-5	16½	12½	21½	15½	8	20	34
G-250	14	14	19	12½	8	17	31
I-W	15	15	28	13½	11	60	80
PS-5	16½	16½	22½	15½	8	20	34
PS-2	14	14	20	12½	8	18	32
Sunlight	15½	15½	19	15½	9	10	25



Western Electric

FLOOD LIGHTING

DAVIS FLOODLIGHT PROJECTORS

General

Flood lighting has come rapidly to the front as a simple and effective means to illuminate out-door areas at minimum expense. This rapid growth can be attributed to the many advantages flood lighting systems offer in projecting light to inaccessible points without undue initial cost or maintenance difficulties. The lighting of Niagara Falls, the Statue of Liberty and many prominent buildings, although presenting insurmountable difficulties to all other methods of lighting, has been accomplished easily by flood lighting. Flood lighting has also solved the problem of lighting railroad yards and night construction work.

The manufacturers of Davis Projectors, pioneers in this field, have kept abreast of developments by designing new Floodlights to meet each new requirement. At present this line consisting of Searchlights, Beamlights and Floodlights is complete in every respect.

Distinguishing Points of Construction

REFLECTORS are accurate parabolic designs made of highly polished crystal glass, the back of which is coated with chemically pure silver, amply protected by a coating of copper and over which is placed a special acid and weather-proof backing.

If an amber color is desired Golglas Reflectors can be substituted for the clear reflectors, without additional cost.

FOCUSING MECHANISMS are all externally operated and do not require tools for making adjustments. By moving the lamp filament in or out of the focal point the beam divergence may be controlled within certain limits.

MOUNTING—All Davis Projectors except the Sunlight Type are supplied complete with both base and bracket mountings and are equipped with universal joints to permit projection in any direction.

FRONT GLASS—On all Davis Projectors, except the Model I-W, a one-piece, heat resisting front glass is supplied which will withstand any weather or temperature condition without cracking. Colored front glasses can be supplied at a slight additional cost. The standard colors are ruby, amber, green and blue.

HOUSING—The construction of the various housings is in keeping with the use for which the projector has been designed.

FINISH—A rust resisting and weatherproof finish of rubberized black enamel gives these projectors a neat appearance enhancing the high class of workmanship incorporated throughout.

PACKING—All Davis Projectors are packed in individual cylindrical wooden drums. This method of packing gives minimum shipping weight with absolute safety, and insures the projectors arriving on the job in good condition.

Western Electric

FLOOD LIGHTING

TECHNICAL AND INSTALLATION INFORMATION

I. WHICH PROJECTOR TO USE.

The choice of a projector for any given flood lighting problem, depends almost entirely on two things; the size of the area to be illuminated, and the distance it is located from the projectors.

The intensity of illumination throughout an area depends entirely on the light thrown on it by the projectors. It follows that the projector which puts the most light into the projected beam, and has an angle of spread which confines the light within the limits of the area, is the projector to use. From this it will be seen that Beamlights (narrow beam projectors) are most suitable for long throws and small areas, and that Floodlights (wide beam projectors) are most satisfactory for short throws and large areas.

II. TO FIND REQUIRED NUMBER OF PROJECTORS

This is done most quickly and accurately by making a scale drawing of the building or area to be lighted and from the point where the projectors are to be located drawing the beam angles until they strike the area to be illuminated. The best way to do this is to use pieces of paper in the form of triangles, the apex angle of the triangle being equal to the angle of spread. By placing these papers on the scale drawing, the number and location of projectors required to uniformly light the area can be quickly determined. For this calculation always use the concentrated beam angle.

The beam from a Floodlight Projector is conical. When it strikes the area at right angles the spot of light is circular and at any other angle the spot of light is elliptical. Therefore, in order to obtain accurately the number of projectors required, it is advisable to use both plan and elevation drawings of the area to be lighted.

To find the number of lumens of light which must be delivered to the surface to be illuminated, multiply the area of the surface by the desired foot candle intensity. Divide this figure by the number of lumens in the beam of the projector to be used and the result will be the required number of projectors. Obviously the number of projectors should be equal at least to the number found necessary to uniformly light the area.

III. LOCATION OF PROJECTORS AND FOCUSING.

Projectors should always be mounted so the beam strikes the area to be illuminated as nearly as possible at right angles. When the area to be lighted is large, the projectors should be grouped in two or more batteries. This allows projection from different angles and causes the beams to overlap and even up the illumination eliminating objectionable shadows.

Projectors should always first be directed with concentrated beams, and final adjustment be given by spreading the beam as little as possible to obtain even illumination. To facilitate this adjustment all Davis Projectors have an external focusing mechanism operated without tools.

IV. RAILROAD USE.

Because of the large areas involved, and the long throws, flood lighting of railroad yards is figured best from the following empirical rules which are only for classification yards. In other types of yards the same number of projectors will be satisfactory for 50 per cent. more tracks.

The following table will be found very satisfactory for estimating the number of lights required for a yard extending two thousand feet between lighting towers:

4—	Model I-W Projectors at each end for	5-10 tracks
6—	" " " " " " " "	10-20 "
8—	" " " " " " " "	20-30 "

The projectors should be 70 feet above the ground and directed as nearly as possible parallel to the tracks.

CHARACTERISTICS OF DAVIS FLOODLIGHTS

INTENSITIES RECOMMENDED

Buildings, statues, etc.	
White.....	3-6 f. c.
Light Color.....	6-12 "
Medium Dark Color	10-20 "
Billboards and Signs..	10-30 "
Beaches.....	.25-2.0 "
Building Construction	2-4 "
Drill Grounds.....	.5-3 "
Outdoor Athletics....	2-6 "
Playgrounds.....	1-3 "
Protection Lighting..	.25-1 "

Projector	*Angle of Spread		Size Watts	Lumens in Beam	
	Smooth Ref.	Hammered Ref.		Smooth Ref.	Hammered Ref.
Sunlight	22° -37°		500	3400	.....
PS-2		32°-64°	200	.....	1465
PS-5	17° -28°	28°-35°	500	2930	2475
I-W	12° -34°	19°-43°	1000	3575	4640
G-250	10½°-21°		250	1200	.....
G-5	11° -28°		500	3100	.....
Searchlight	7.8°		1000	4750	.....

*The first figure is the divergence of the maximum concentrated beam and the second figure the maximum spread beam.

Western Electric

SUNBEAM MAZDA LAMPS

Watts	Bulb	Rated Initial Lumens	Rated Initial Lumens Per Watt	Mean Lumens Per Cent of Aver. Initial Lumens	Mean L. P. W. Per Cent of Rated Initial	Hours Life	Screw Base	Max. Overall Length Inches	Light Center Length Inches	Fil. Const.	Position of Burning	Std. Pkg. Qty.
GENERAL LIGHTING SERVICE—MAZDA B LAMPS—110, 115 AND 120 VOLTS												
10	S-17 cl	82	8.2	92	96	1000	Med.	5 $\frac{1}{16}$	....	S-1	Any	120
15	S-17 cl	131	8.7	92	95	1000	Med.	5 $\frac{1}{16}$	....	S-1	Any	120
25	S-17 cl	233	9.3	87	91	1000	Med.	5 $\frac{1}{16}$	....	S-1	Any	120
40	S-19 cl	400	10.0	85	89	1000	Med.	5 $\frac{1}{16}$	....	S-1	Any	120
50	S-19 cl	500	10.0	82	87	1000	Med.	5 $\frac{1}{16}$	....	S-1	Any	120
60	S-21 cl	612	10.2	81	85	1000	Med.	5 $\frac{1}{16}$	....	S-1	Any	120
GENERAL LIGHTING SERVICE—MAZDA B MILL TYPE LAMPS—110, 115 AND 120 VOLTS												
25	P-19 cl(M)	218	8.7	....	....	1000	Med.	3 $\frac{15}{16}$	2 $\frac{1}{2}$	C-9	Any	120
50	P-19 cl(M)	450	9.0	....	....	1000	Med.	3 $\frac{15}{16}$	2 $\frac{1}{2}$	C-9	Any	120
GENERAL LIGHTING SERVICE—WHITE MAZDA C LAMPS—110, 115 AND 120 VOLTS												
50	PS-20 wh	*440	....	....	....	1000	Med.	5 $\frac{3}{8}$	....	C-9	Any	60
75	PS-22 wh	*785	....	....	....	1000	Med.	5 $\frac{3}{8}$	....	C-9	Any	60
GENERAL LIGHTING SERVICE—MAZDA C LAMPS—110, 115 AND 120 VOLTS												
50	PS-20 cl	500	10.0	....	....	1000	Med.	5 $\frac{9}{16}$	3 $\frac{3}{4}$	C-9	Any	60
75	PS-22 cl	893	11.9	91	91	1000	Med.	6 $\frac{3}{16}$	4 $\frac{5}{16}$	C-9	Any	60
100	PS-25 cl	1290	12.9	91	91	1000	Med.	7 $\frac{1}{4}$	5 $\frac{3}{16}$	C-9	Any	24
150	PS-25 cl	2145	14.3	90	90	1000	Med.	7 $\frac{1}{4}$	5 $\frac{3}{16}$	C-9	Any	24
200	PS-30 cl	3100	15.5	90	91	1000	Med.	8 $\frac{7}{16}$	6	C-9	Any	24
300	PS-35 cl	4950	16.5	90	91	1000	Mog.	9 $\frac{9}{16}$	†7	(C-7 Base up) (C-9 Any)		24
500	PS-40 cl	9050	18.1	90	90	1000	Mog.	10 $\frac{5}{16}$	†7	C-7	Base up	12
750	PS-52 cl	14325	19.1	85	85	1000	Mog.	13 $\frac{3}{16}$	†9 $\frac{1}{2}$	C-7	Base up	8
1000	PS-52 cl	20200	20.2	85	85	1000	Mog.	13 $\frac{3}{16}$	†9 $\frac{1}{2}$	C-7	Base up	8
GENERAL LIGHTING SERVICE—MAZDA C DAYLIGHT LAMPS—110, 115 AND 120 VOLTS												
50	PS-20 day	*338	....	....	....	700	Med.	5 $\frac{9}{16}$	3 $\frac{3}{4}$	C-9	Any	60
75	PS-22 day	*614	....	....	....	700	Med.	6 $\frac{3}{16}$	4 $\frac{5}{16}$	C-9	Any	60
100	PS-25 day	*871	....	....	....	700	Med.	7 $\frac{1}{4}$	5 $\frac{3}{16}$	C-9	Any	24
150	PS-25 day	*1433	....	....	....	700	Med.	7 $\frac{1}{4}$	5 $\frac{3}{16}$	C-9	Any	24
200	PS-30 day	*2119	....	....	....	700	Med.	8 $\frac{7}{16}$	6	C-9	Any	24
300	PS-35 day	*3374	....	....	....	700	Mog.	9 $\frac{9}{16}$	†7	(C-7 Base up) (C-9 Any)		24
500	PS-40 day	*6273	....	....	....	700	Mog.	10 $\frac{5}{16}$	†7	C-7	Base up	12
SPECIAL LIGHTING SERVICE—MAZDA C LAMPS—FLOODLIGHTING—110, 115 AND 120 VOLTS												
250	G-30 cl	3250	13.0	....	....	800	§Med.	5 $\frac{9}{16}$	3	C-5	zBase down	24
500	G-40 cl	7900	15.8	....	....	800	Mog.	7 $\frac{5}{8}$	4 $\frac{1}{4}$	C-5	zBase down	12

* Approximate value. † Tipless bulb. § This lamp may be obtained with unskirted mogul screw base at same price having a light center length of 3 $\frac{3}{8}$ inches and a maximum over-all length of 5 $\frac{5}{16}$ inches. † The light center length of lamps for base down burning is approximately one-half an inch less than this figure. z Can be burned in any position except within 45 degrees of vertically base up.

The MAZDA lamp has assumed such an important part in present lighting practice that a knowledge of the more important characteristics of these lamps will be found useful. Perhaps, first of all, the distinction between the vacuum lamps and those containing an inert gas within the bulb should be made clear.

OPERATING PRINCIPLES OF MAZDA B LAMPS

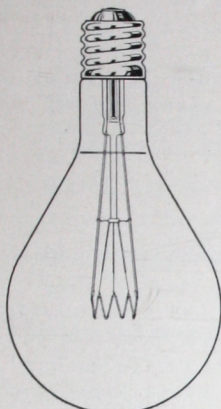
MAZDA B electric incandescent lamp filaments are operated in bulbs from which practically all air and gases have been removed. The evacuation of the bulb accomplishes two purposes; first, it prevents the filament being consumed by the oxygen of the air; second, it prevents the loss of heat from the filament by convection. It is desirable from the standpoint of efficient transformation of electric energy into light to operate the filament at the highest temperature that it can withstand without causing it to evaporate at any excessively rapid rate. The life of the lamp depends upon the ability of the filament to withstand evaporation. Metallic filaments are used in MAZDA B lamps and produce much more light for a given consumption of energy than the older carbon-filament lamps, and give a more satisfactory life performance.

OPERATING PRINCIPLES OF MAZDA C LAMPS

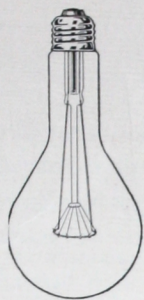
If the rate of evaporation can be reduced, the filaments can be operated at a higher temperature and other things being equal, at a higher efficiency. Inert gases introduced into the bulb of the MAZDA C lamp increase the pressure bearing upon the filament, and the practicable operating temperature is thereby increased. The helically coiled tungsten filament permits mounting in a small space near the center of the bulb, and the percentage loss through the gas was greatly reduced with the result that these MAZDA C lamps became at once commercially practical in the higher wattages.

Western Electric

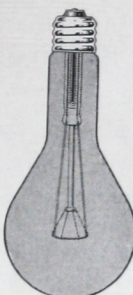
SUNBEAM MAZDA LAMPS



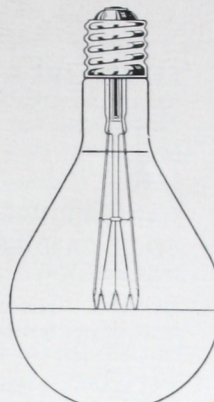
PS-Bulb
300 Watts and Over
Mogul Base



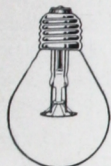
PS-Bulb
50 to 200 Watts
Medium Base



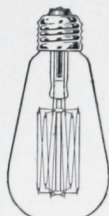
PS-Bulb
Daylight



PS-Bulb
Bowl Enamel



P-Bulb
Mill Type



S-Bulb



PS-Bulb
White
Mazda



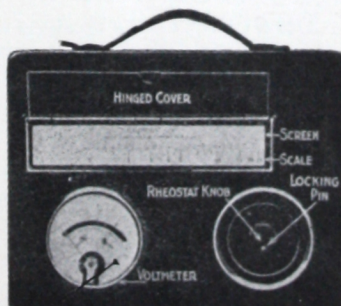
S-Bulb
Sign

HOW TO ORDER LAMPS

- 1—All orders should specify whether Sunbeam MAZDA B, Sunbeam MAZDA C, Sunbeam MAZDA Daylight, MAZDA Mill Type or White MAZDA lamps are desired and should give the following information:
- 2—QUANTITY—Number of lamps desired. Purchasers will avoid delays and get best discount by ordering package quantities.
- 3—SIZE OF LAMPS—Specify wattage of multiple lamps and lumens of series lamps.
- 4—VOLTAGE—For multiple lamps.
- 5—BULB—For example: S-19, G-30, P-19, PS-25, etc. The letter in the bulb designation indicates its shape and the figure its diameter in eighths of an inch. Thus an S-19 bulb is straight-sided and is $1\frac{19}{8}$ or $2\frac{3}{8}$ inches in diameter. G indicates a round (globular), P and PS a pear-shape bulb.
- 6—FINISH OF BULB—Clear, bowl enameled, or all frosted.
- 7—BASE—Medium screw or mogul screw.
- 8—SERVICE—For example: Stereopticon, Floodlighting, Locomotive Headlight, etc.

FOOT-CANDLE METER

The foot-candle meter has been designed to measure foot-candle intensities quickly and with a fair degree of accuracy. It is very simple in operation, and so small that readings can be taken in very restricted spaces. Technical knowledge is not necessary to use it. In operation, it is placed upon or adjacent to the surface on which a measurement of the foot-candle intensity is desired. The rheostat is adjusted until the voltmeter shows that the voltage of the lamp within is up to that at which the instrument was calibrated. Note, without obstructing the light to be measured, the point where the spots are neither brighter nor darker than the white paper scale. The scale is accurately calibrated to read direct within the limits of from 1 to 40 foot candles.



Western Electric

DEFINITIONS

LUMINAIRE is a new word in lighting nomenclature coined to meet the demand for a more suitable name for lighting units than the old name "Lighting Fixture." Its adoption was brought about largely by the advent of Elexits,¹ wherein a fixture became movable.

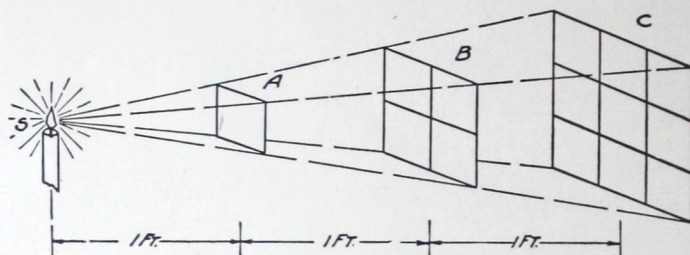
LIGHT is luminous flux which produces visual sensation.

CANDLEPOWER is luminous intensity expressed in candles.

FOOT-CANDLE is the intensity of illumination obtained on a surface one foot distant from a source of one candlepower.

LUMEN—The quantity of light necessary to illuminate one square foot of area to an intensity of one foot-candle is called a lumen. That is, one lumen per square foot is equal to one foot-candle.

INTENSITY OF ILLUMINATION at any point is flux density at that point.² It is expressed in "foot-candles" or "lumens per square foot."



In the above diagram assume A to be one foot distant from a source of one candlepower. The illumination on A will be one foot-candle and consequently the flux density will be one lumen per square foot. That is, the quantity of light in the angle is one lumen, as A is one square foot in area.

If without changing the angle, the light is allowed to pass to plane B, two feet away, the illumination will be less. That is, although the quantity of light remains the same (one lumen), the area has increased to four square feet and consequently the flux density is one-fourth lumen per square foot or one-fourth foot-candle.

Similarly, at a distance of three feet the area will be nine square feet and the flux density one-ninth lumens per square foot or one-ninth foot-candle.

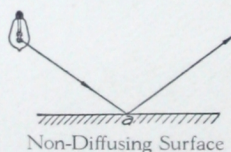
GLARE is caused by any brightness in the field of vision of such a character as to cause discomfort, annoyance, interference with vision or eye fatigue.

BRIGHTNESS is the light flux emitted per unit of projected area. It is expressed in lamberts or candlepower per square inch.

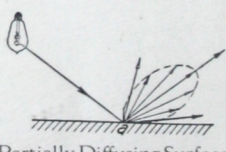
Lamberts may be reduced to candlepower per square inch by dividing by .487.

DIFFUSION is the breaking up of a beam of light.

A diffusing surface is one which is capable of breaking up a light beam. This is shown graphically below.



Non-Diffusing Surface



Partially Diffusing Surface
Smooth Paper, etc.



Perfectly Diffusing Surface
White Plaster, White Blotting Paper, etc.

Western Electric

DEFINITIONS

(Continued)

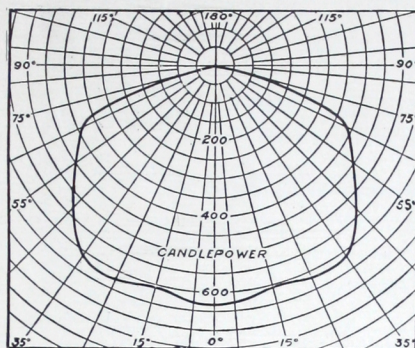
ABSORPTION FACTOR of a surface is the ratio of the flux absorbed by the surface to the light incident upon it.

BRIGHTNESS CONTRAST is the difference in brightness between the source of light and other objects in the visual field.

COEFFICIENT OF UTILIZATION is the ratio of the useful light to the generated light. It is usually expressed as a decimal fraction.

PHOTOMETRIC CURVES are curves which graphically represent the candlepower in any direction. That is, the length of the line drawn between the center and the curve represents the candlepower to a definite scale.

For convenience distribution curves are drawn on polar coordinate paper, similar to the illustration, which shows the RLM curve. This paper shows two series of lines, concentric circles equidistant from each other, representing candlepower; and radial lines from the common center which represent the angle at which the light is measured.



DISTRIBUTION CURVE, RLM REFLECTOR

Assume that the candlepower at 45° is desired. Find the 45° radial line on the above curve and follow it until it intersects the curve proper. The point of intersection is found to lie about .6 the distance between the 500 and 550 candlepower circles. That is, the candlepower at 45° is

$$500 + (.6 \times 50) = 530 \text{ candlepower.}$$

ZONES IN PHOTOMETRIC CURVES are divisions measured between angles. That is, the light flux in the 0°-60° zone would mean the light flux which the unit emitted in the cone between the 0° and the 60°.

COEFFICIENT OF REFLECTION of a surface is the ratio of the reflected light to the incident light. It is usually expressed in percent.

Coefficient of Reflection of Colored Surfaces

1. White.....	81%	9. Satin Green.....	67%
2. Ivory White.....	76%	10. Primrose.....	67%
3. Gray White.....	73%	11. Buff.....	59%
4. Ivory.....	72%	12. Shell Pink.....	57%
5. Caen Stone.....	50%	13. Pale Azure.....	36%
6. Lichen Gray.....	70%	14. Salmon Pink.....	51%
7. Pearl Gray.....	70%	15. Silver Gray.....	50%
8. Light Gray.....	67%	16. Bright Sage.....	43%

GOOD VALUES OF FOOT-CANDLE ILLUMINATION FOR STORES, COMMERCIAL AND PUBLIC INTERIORS

	—Desirable Illumination— Foot-Candles Usual Average Conditions Range			—Desirable Illumination— Foot-Candles Usual Average Conditions Range	
Armories, Public Halls	5	3-6	Motion Picture Theatres:		
Auditoriums	3	2-4	During Intermission	3	2-4
Automobile Show Rooms	8	5-10	During Pictures	1	0.1-0.2
Banks:			Office Buildings:		
Cases and Offices	10	6-12	File Room	4	3-6
Lobby	6	4-8	General Office	10	6-12
Barber Shops	8	5-10	Private Offices	10	6-12
Basket Ball and Indoor Baseball	10	6-12	Stenographer and Bookkeeping Rooms	10	6-12
Billiards:			Vault	4	3-6
General	4	3-6	Railway Stations:		
On Table	15	10-20	Baggage Room		3-6
Bowling:			Concourse		1-2
On Alley, runway and sets	5	3-6	Rest Room, Smoking Room		1-3
On Pins	15	10-20	Ticket Offices, etc. (See Offices)		0-10
Cars:			Train Platform		0.5-1
Baggage	4	3-6	Waiting Room		2-4
Day Coach, Subway	6	4-8	Racquet Courts	8	6-12
Dining	6	4-8	Restaurants	5	4-8
Mall	10	6-12	Schools:		
Pullman	6	4-8	Auditorium	5	4-8
Street Railway	6	4-8	Class Rooms, Library and Office	8	5-10
Churches:			Corridors and Stairways	2	1-2
Auditorium	3	2-4	Drawing	15	10-20
Sunday School Room	5	3-6	Laboratories	10	6-12
Club Rooms	4	3-6	Manual Training Shops	10	6-12
Court Rooms	6	4-8	Sewing Rooms	15	10-20
Dance Halls	4	3-6	Study Room:		
Dental Offices:			Desk	8	5-10
Office	15	10-20	Blackboards	6	4-8
Waiting Rooms	4	3-6	Show Windows:		
Department Stores and Large Specialty Stores:			Light Goods		20-50
Basement Stores	8	5-10	Dark Goods		30-75
Main Floors	10	6-12	Skating Rinks	5	4-8
Other Floors	8	5-10	Small Stores:		
Depots—Waiting	4	3-6	Art	8	5-10
Drafting Rooms	15	10-20	Automobile Supply	6	4-8
Elevators—Freight and Passenger	4	3-6	Bake Shop	6	4-8
Exclusive Small Stores:			Book	6	4-8
Dark Goods	12	8-16	China	6	4-8
Light Goods	8	5-10	Cigar	8	5-10
Fire Engine Houses:			Clothing	8	6-12
At other times	1-2		Confectionery	8	5-10
When alarm is turned in	4-6		Dairy Products	6	4-8
Garages	6	4-8	Decorator	8	5-10
Gymnasium:			Drug	8	5-10
Fencing, Boxing, Wrestling	8	5-10	Dry Goods	8	5-10
Locker Rooms	4	3-6	Electrical Supply	8	5-10
Main Exercising Floor	8	5-10	Florist	6	4-8
Swimming Pool	4	3-6	Furrier	8	5-10
Shower Rooms	4	3-6	Grocery	6	4-8
Halls, Passageways in Interiors	2	1-2	Haberdashery	8	6-12
Handball Courts	8	6-12	Hardware	6	4-8
Hospitals:			Hat	8	6-12
Corridors	2	1-2	Jewelry	8	5-10
Lobby and Reception Room	4	3-6	Leather, Handbags and Trunks	6	4-8
Operating Table	75	50-100	Meat	6	4-8
Operating Room	10	6-12	Millinery	8	6-12
Wards and Private Rooms			Misc	8	5-10
with local illumination	2	1-2	Notions	6	4-8
with no local illumination	5	1-6	Piano	6	4-8
night illumination	0.1	0.1-0.2	Shoe	8	6-12
Hotels:			Sporting Goods	8	5-10
Bedrooms	6	4-8	Tailor	8	5-10
Corridors	1	1-2	Tobacco	8	5-10
Dining Room	5	4-8	Variety Store	10	6-12
Lobby	4	3-6	Stores of Medium Size:		
Kitchen	6	4-8	Clothing, Dry Goods, Furniture, etc.	8	5-10
Writing Room	8	5-10	Studios:		
Laboratories	10	6-12	Art and Photographic	10	6-12
Libraries:			Motion Picture—General	5	3-6
Reading Rooms	8	5-10	Sets (Photographic Daylight)	500-2000	
Stack Room	4	3-6	Squash Courts	8	6-12
Lodge Rooms	4	3-6	Telephone:		
Lunch Rooms	8	5-10	Manual Exchanges	5	3-6
Markets	8	5-10	Automatic Exchanges	10	6-12
Museums:			Tennis (Indoor)	8	6-12
General	5	4-8	Theatres:		
On Walls	8	5-10	Auditorium	4	3-6
			Foyer	5	3-6
			Lobby	8	5-10
			Toilet and Washrooms	4	3-6

GOOD VALUES OF FOOT-CANDLE ILLUMINATION FOR INDUSTRIAL INTERIORS

	—Desirable Illumination— Foot-Candles Usual Average Conditions Range			—Desirable Illumination— Foot-Candles Usual Average Conditions Range	
Offices:			Boilers, Engine Rooms and Power Houses:		
Private, General	10	6-12	Boilers, Coal and Ash-Handling, Storage Battery Rooms	3	2-4
Drafting Room	15	10-20	Auxiliary Equipment, Oil switches and Transformers	5	3-6
Industrial:			Switchboards, Engines, Generators, Blowers, Compressors	6	4-8
Aides, stairways, Passageways and Corridors	2	1-2	Book Binding:		
Assembling:			Folding, Assembling, Pasting, etc.	5	3-6
Rough	5	3-6	Cutting, Punching and Stitching	8	5-10
Medium	8	5-10	Embossing	10	8-12
Fine	10	8-16	Candy Making	8	5-10
Extra Fine	10-50		Canning and Preserving	8	5-10
Automobile Storage	2	1-2	Chemical Works:		
Bakeries	8	5-10	Hot Furnaces, Boiling Tanks, Stationary Driers, Stationary and Gravity Crystallizing	3	2-4

NOTE Electrical Record, Vol. XXXII, No. 2

GOOD VALUES OF FOOT-CANDLE ILLUMINATION FOR INDUSTRIAL INTERIORS (Continued)

	—Desirable Illumination— Foot-Candles Usual Average Conditions Range			—Desirable Illumination— Foot-Candles Usual Average Conditions Range	
Mechanical Furnaces, Generators and Stills, Mechanical Driers, Evaporators, Filtration, Mechanical Crystallizing, Bleaching	4	3-6	Paper Box Manufacturing:		
Tanks for Cooking, Extractors, Percolators, Nitraters, Electrolytic Cells	6	4-8	Light	6	4-8
Clay Products and Cement:			Dark	8	5-10
Grinding, Filter Presses, Kiln Rooms	3	2-4	Storage of Stock	3	2-4
Molding, Pressing, Cleaning and Trimming	5	3-6	Paper Manufacturing:		
Enameling	6	4-8	Beaters, Machine, Grinding	4	3-6
Coloring and Glazing	10	6-12	Calendering	6	4-8
Cloth Products:			Finishing, Cutting and Trimming	8	6-12
Cutting, Inspecting Sewing:			Plating	5	3-6
Light Goods	10	6-12	Polishing and Burnishing	8	5-10
Dark Goods	20	10-50	Printing Industries:		
Pressing, Cloth Treating (Oilcloth, etc.):			Matrixing and Casting, Miscellaneous Machines, Presses	8	5-10
Light Goods	8	5-10	Proof Reading, Lithography, Electrotyping	10	6-12
Dark Goods	12	8-16	Linotype, Monotype, Typesetting, Imposing Stone, Engraving	10-50	....
Coal Breaking, Washing, Screening	3	2-4	Receiving and Shipping	4	3-6
Construction—Indoor General	3	2-4	Rubber Manufacturing and Products:		
Dairy Products	8	5-10	Calenders, Compounding Mills, Fabric Preparation, Stock-Cutting, Tubing Machines, Solid Tire Operations, Mechanical Goods, Building, Vulcanizing	8	5-10
Electric Manufacturing:			Bead Building, Pneumatic Tire Building and Finishing, Inner Tube Operation, Mechanical Goods Trimming, Tread-Ing	10	6-12
Storage Battery Molding of Grids, Charging Room	6	4-8	Sheet Metal Work:		
Coil Armature Winding, Mica Working Insulating Processes	10	8-16	Miscellaneous Machines, Ordinary Bench Work	8	5-10
Elevators, Freight and Passenger	5	3-6	Punches, Presses, Shears, Stamps, Welders, Spinning, Fine Bench Work	10	8-16
Engraving	20	10-50	Tin Plate Inspection	10	6-12
Forge Shops and Welding:			Shoe Manufacturing:		
Rough Forging	6	4-8	Hand Turning, Miscellaneous Bench and Machine Work	8	5-10
Fine Forging and Welding	10	6-12	Inspecting and Sorting Raw Material, Cutting, Lasting and Welding (light)	10	6-12
Foundries:			Inspecting and Sorting Raw Material, Cutting, Stitching (dark)	10-50	....
Charging Floor, Tumbling, Cleaning, Pouring and Shaking Out*	5	3-6	Soap Manufacturing:		
Rough Molding and Core Making	6	4-8	Kettle Houses, Cutting, Soap Chip and Powder	5	3-6
Fine Molding and Core Making	10	6-12	Stamping, Wrapping, Packing, Filling and Packing Soap Powder	6	4-8
Glass Work:			Steel and Iron Mills, Bar, Sheet and Wire Products:		
Mix and Furnace Rooms, Pressing and Lehr Glass Blowing Machines	6	4-8	Soaking Pits and Reheating Furnaces	2	1-2
Grinding, Cutting Glass to Size, Silvering	8	5-10	Charging and Casting Floors	3	2-4
Fine Grinding, Polishing, Beveling, Inspection, Etching and Decorating	10	6-12	Muck and Heavy Rolling, Shearing, rough by gauge, Pickling and Cleaning	5	3-6
Glass Cutting (cut glass) Inspecting Fine	10-50	....	Plate Inspection	15	10-20
Glove Manufacturing:			Automatic Machines, Rod, Light and Cold Rolling, Wire-drawing, Shearing, Fine by line	6	4-8
Light Goods	8	5-10	Stone Crushing and Screening:		
Cutting, Pressing, Knitting	10	8-16	Belt Conveyor Tubes, Main Line Shafting Spaces, Chute Rooms, Inside of Bins	2	1-2
Sorting, Stitching, Trimming and Inspecting	10	8-16	Primary Breaker Room, Auxiliary Breakers under Bins	3	2-4
Dark Goods	20	10-50	Screen Rooms	5	3-6
Cutting, Pressing, Knitting	20	10-50	Store and Stock Rooms:		
Sorting, Stitching, Trimming and Inspecting	20	10-50	Rough	2	1-3
Hat Manufacturing:			Medium	4	3-6
Dyeing, Stiffening, Braiding, Cleaning and Refining:			Structural Steel Fabrication	6	4-8
Light	6	4-8	Sugar Grading	16	10-20
Dark	10	6-12	Telephone:		
Forming, Slating, Pouncing, Flanging, Finishing, Ironing:			Manual Exchanges	5	3-6
Light	8	5-10	Automatic Exchanges	10	6-12
Dark	10	6-12	Testing:		
Beveling	10	8-16	Rough	5	3-6
Light	10-50	....	Fine	10	6-12
Ice Making:			Extra Fine Instruments, Scales, etc.	20	10-50
Engine and Compressor Room	6	4-8	Textile Mills:		
Inspecting:			Cotton:		
Rough	6	4-8	Opening and Lapping, Carding, Drawing, Frame Roving, Dyeing	5	3-6
Medium	10	6-12	Spooling, Spinning, Drawing in, Warping, Weaving, Quilling, Inspecting, Knitting, Slashing (over beam end)	8	5-10
Fine	15	10-20	Silk:		
Extra Fine	10-50	....	Winding, Throwing, Dyeing	12	8-16
Jewelry and Watch Manufacturing	10-50	....	Quilling, Warping, Weaving and Finishing:		
Laundries and Dry Cleaning	8	5-10	Light Goods	8	5-10
Leather Manufacturing:			Dark Goods	10	8-16
Vats	3	2-4	Woolen:		
Cleaning, Tanning and Stretching	4	3-6	Carding, Picking, Washing and Combing	4	3-6
Cutting, Fleshing and Stuffing	6	4-8	Twisting and Dyeing	6	4-8
Finishing and Seaming	10	6-12	Drawing in Warping:		
Leather Working:			Light Goods	6	4-8
Pressing and Winding:			Dark Goods	10	8-16
Light	8	5-10	Weaving:		
Dark	10	6-12	Light Goods	8	5-10
Grading, Matching, Cutting, Seaming, Sewing:			Dark Goods	12	10-20
Light	10	8-16	Knitting Machines	10	6-12
Dark	10-50	....	Tobacco Products:		
Locker Rooms	4	2-4	Drying, Stripping, General	2	1-3
Machine Shops:			Grading, Sorting	15	10-20
Rough Bench and Machine Work	6	4-8	Toilet and Wash Rooms	4	3-6
Medium Bench and Machine Work, Ordinary Automatic Machines, Rough Grinding, Medium Buffing and Polishing	10	6-12	Warehouse	2	1-2
Fine Bench and Machine Work, Fine Automatic Machines, Medium Grinding, Fine Buffing and Polishing	12	8-16	Wood Working:		
Extra Fine Bench and Machine Work, Grinding (fine work)	10-50	....	Rough Sawing and Bench Work	5	3-6
Meat Packing:			Slat, Planing, Rough Sanding, Medium Machine and Bench Work, Gluing, Veneering, Cooperage	8	5-10
Slaughtering	5	3-6	Fine Bench and Machine Working, Fine Sanding and Finishing	8	6-12
Cleaning, Cutting, Cooking, Grinding, Canning, Packing	8	5-10			
Milling and Grain Foods:					
Wearing, Grinding or Rolling	5	3-6			
Baking or Roasting	8	5-10			
Flour Grading	16	10-20			
Packing:					
Crating	4	3-6			
Boxing	6	4-8			
Paint Manufacturing	6	4-8			
Paint Shops:					
Blowing, Spraying, Firing	5	3-6			
Rubbing, Ordinary Hand Painting and Finishing	8	5-10			
Fine Hand Painting and Finishing	10	8-16			
Extra Fine Hand Painting and Finishing (automobile bodies, piano cases, etc.)	15	10-50			

*Since Pouring and Shaking Out are carried on in the same location as either Rough or Fine Molding, different illumination levels may be secured for these operations by cutting out some of the lighting circuits when the space is used for the former.

A FEW FACTS ON LIGHTING

Lighting is the foremost service electricity renders. Modern standards of lighting have made obsolete much of the equipment now installed. Therefore, this immense field is open in addition to the business resulting from new construction.

Good lighting in stores, offices and factories is a good investment because it helps to increase sales, efficiency and production. Surveys show this industry must yet do a tremendous job of selling to measure up to the possibilities offered.

Of the hundreds of thousands of stores, less than 1 in 20 is reasonably well lighted.

In 1922 the country spent \$500,000,000 for lighting. If the type of lamp used in 1902 had been used the bill would have been \$2,000,000,000. Keeping lighting installations up-to-date will continue to effect savings.

The importance of proper lighting is emphasized by a recent investigation which showed 5,300 employees out of 10,000 had faulty vision. That bad vision adds day by day to production costs. Correct lighting reduces it by offsetting faulty vision.

Among other prospects for commercial lighting are 2,000,000 stores now paying \$180,000,000 a year to the central stations. Raise the foot candles to 10 which most stores need and a gain of \$108,000,000 annual revenue to the central stations will result, to say nothing of the amount of electrical equipment involved.

Tests in one store of Chicago's loop showed "better lighting" increased sales 29%. The method of conducting the test was to change from 5 to 15 foot-candles on alternate days, thus duplicating conditions of time, weather, etc., under each condition of lighting.

The average store in your community will show you a place to sell window illumination.

106 tests in the show windows of 3 different stores showed that 100 persons stopped to look at a display lighted to 15 foot-candles, 133 stopped with 40 foot-candles and 100 foot-candles stopped 173 persons.

Total estimated building construction for 1924:
(Architectural Forum Jan. 1924)

New England States.....	422,895,800
North Atlantic States.....	1,570,339,100
South Eastern States.....	223,882,000
" Western States.....	386,132,900
Middle States.....	2,169,959,700
Western States.....	787,158,200

5,560,367,700

The electrical industry—particularly the lighting end of it—will share in this vast building expenditure to the degree that the separate interests co-operate for the mutual benefit of all.

Figure the value of a window in dollars a day or a week and the relation between foot-candles, observers and possible buyers is obvious.

Western Electric

A FEW FACTS ON LIGHTING

A merchant on a side street put up an electric sign. It cost the equivalent of two months' rent but he got his money back soon. One month after the sign was up, his business grew 162%; 2nd month 174%; 3rd month 180%; 4th month 178%.

Light points right to the store of the merchant who uses electric signs. It says, "Stop! Look! Loosen!"

Light is a salesman and should always be kept in good condition. Use lots of soap and water for lighting systems, wash reflectors and lamps—fill empty sockets—replace blackened lamps and refinish ceilings and high side walls in white or very light cream color. Proper lighting maintenance is worth the attention of reliable men.

Offices in general are poorly lighted. It has been proved that the speed of reading was increased 64% when illumination was raised from 4 to 25 foot-candles. Office workers perform quicker and more accurately under correct light.

Tests in a post office showed employees working under 2 to 3 foot-candles had less normal vision and more eye defects than employees in another office working under 3 to 4 foot-candles. In the same tests letter separators increased their speed 4.4% when the illumination was raised from 3.6 to 8 foot-candles.

Factories are notoriously under-illuminated. Witness the thousands of preventable accidents occurring attributable to poor lighting.

A summary of nine separate investigations showed an average production increase of 15.5% when the illumination was raised from an average 2.3 foot-candles to an average of 11.2 foot-candles. The additional lighting cost in the nine plants averaged 1.9% of the payroll.

Fifteen months' figures in an automotive plant showed 25% increase of production when the illumination was raised from 1.2 foot-candles to 18 foot-candles. The increased cost was 2% of the payroll.

Tests in a semi-automatic buffing department showed 8.5% increase in production when the illumination of 3.8 foot-candles was raised to 11.4 foot-candles.

There is work for years ahead improving lighting conditions which benefit the whole electrical industry and the public at large.

Western Electric

Western Electric Company

NEW YORK
BROOKLYN
NEWARK
SYRACUSE
BUFFALO
NEW HAVEN
BOSTON
PROVIDENCE
PITTSBURGH

PHILADELPHIA
BALTIMORE
ATLANTA
SAVANNAH
NEW ORLEANS
BIRMINGHAM
JACKSONVILLE
RICHMOND
NORFOLK
CHARLOTTE

CHICAGO
INDIANAPOLIS
MILWAUKEE
GRAND RAPIDS
DETROIT
CLEVELAND
MINNEAPOLIS
ST. PAUL
DULUTH

YOUNGSTOWN
KANSAS CITY
OMAHA
ST. LOUIS
MEMPHIS
CINCINNATI
COLUMBUS
NASHVILLE
DALLAS
HOUSTON

SAN FRANCISCO
OAKLAND
LOS ANGELES
SEATTLE
PORTLAND
SPOKANE
TACOMA
DENVER
SALT LAKE CITY

